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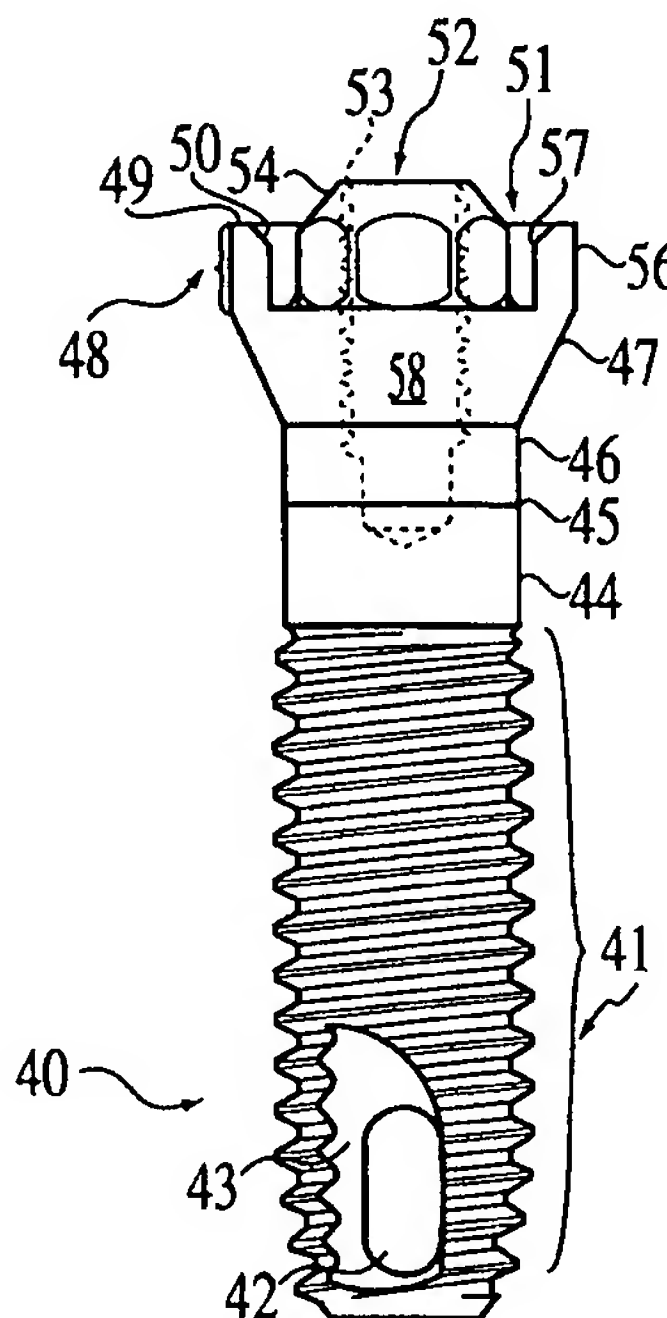
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(54) **Non-submergible, one part, root form endosseous dental implants**

(57) One-piece, root-form, endosseous dental implants include, in a single implant, a body portion for insertion into an opening in the jawbone of a patient, a neck portion above the body portion, and an abutment portion above the neck portion. The abutment portion includes a peripheral shoulder and an opening into an internally-threaded shaft. The implant may also include internal or external wrench-engaging surfaces.



**FIG. 1**

**EP 0 879 580 A2**

## Description

This application is a continuation-in-part of co-pending U. S. Patent Application Serial No. \_\_\_\_\_ filed on May 30, 1997, which is a continuation-in-part of Application Serial No. 08/857,088 filed on May 15, 1997 in the U. S. Patent & Trademark Office, and entitled "NON-SUBMERGIBLE, ONE-PART, ROOT-FORM ENDOSSEOUS DENTAL IMPLANTS".

This invention relates to non-submerged, root-form, one-part endosseous dental implants. In preferred embodiments, these implants include a body portion for insertion into an opening in the jawbone of a patient; atop the body portion, a neck portion that is sufficiently long to extend through the gum tissue atop such openings, after proper surgical placement in such openings; and an abutment portion atop the neck portion.

The invention also relates to abutment extenders that fit atop the abutment portion of these new dental implants. In some embodiments, these extenders include an end portion with tapered external wall that mates with a complementary, tapered, external wall surface on the abutment portion of the implants. In other embodiments, the extenders include an end portion with a cavity of sufficient size and shape to fit over the abutment portion of the new implants.

The abutment portion has a shape and size adapted to allow connection, as by splinting, of a plurality of such implants placed in non-parallel sites, diverging from one another by up to about 80 degrees, in a common jawbone. Such a connection may, for example, be a screw-retained cast bar, positioned at or above the mucosal tissue for support and retention of an overdenture, or a screw-retained, fixed bridge. These one-part implants provide greater strength than many two-part, endosseous, root form dental implants by eliminating the junction between the implant and a separate abutment.

Root-form endosseous dental implants are adapted to achieve osseointegration, meaning direct attachment to bone, by avoiding overloading the implants during the 3-4 month healing period following surgical placement in jawbone sites. Two-part dental implants require a 2-stage surgical protocol. The first stage comprises inserting an implant, such as the CORE-VENT®, SCREW-VENT®, MICRO-VENT®, BIO-VENT® and BRANEMARK® implants, into the jaw bone, and burying it beneath the mucosal gum tissue for a submerged healing period. The second stage comprises exposing the top of the implant to allow attachment of an abutment. The abutment has a portion that extends above the gum tissue to allow attachment of a prosthesis. Submerged body implants and even non-submerged implants with a body and neck are usually 2-part implants, requiring attachment to the implant of a separate abutment to support a prosthesis.

One method for attaching an abutment to the top of a 2-part implant body (submerged) or neck (non-sub-

merged) is by a threaded connection. An advantage of a 2-part implant is that a variety of abutment designs can be connected to the implant to meet most aesthetic and functional requirements. Abutments of varying diameters and angularity provide many different aesthetic restorations, and allow proper restoration of non-parallel implants placed in a common jawbone, and connected to one another by, for example, a fixed bridge.

Many 2-part implants include, at the top, a wrench-engaging surface, such as an internal or external, multi-sided feature or spline. Such wrench-engaging surfaces may be used for insertion of threaded implants into an opening in a patient's jawbone, or for connection of one-part or multi-part, screw-retained abutments that engage the wrench-engaging surface to provide anti-rotational stability to the abutment. Such a connection provides a stable base for attachment of a cemented single tooth restoration. However, such connections must withstand millions of cycles of loading from chewing every year without loosening, and high shear forces imposed when the connection is placed at an angle to the biting forces without breaking. Sometimes, as a result, these connections weaken and fail.

The 1-stage surgical protocol comprises inserting an implant, e.g., Straumann's ITI® implant, with its cylindrical neck portion extending through the gum tissue at time of implantation, avoiding the need for a second stage of surgery. Such implants may have a neck portion alone that extends through the gum tissue, or, in addition, to the neck portion, a head portion to function as an abutment for support or retention of a prosthesis. An implant that includes body, neck and head portions is referred to as a 1-part implant.

One-part implants avoid the necessity for a second surgical stage, and are not subject to loosening or breaking of the connection between implant and abutment, as in 2-part implants. Advantageously, the 1-part, root-form endosseous dental implants of this invention are simple, strong, and lower in cost than many 2-part implants. Such 1-part implants require less surgical time for placement in a patient's jawbone by eliminating a second surgery, and the time and expense related to attaching a separate abutment to the implant in the second surgery.

In preferred embodiments, the new 1-part, root-form, endosseous dental implants of this invention include a body portion adapted to be inserted into an opening in a patient's jawbone, and to become attached directly to bone at that site through a process called osseointegration. The body portion of these implants may be wholly or partly externally threaded or unthreaded, as in the SCREW-VENT® or BIO-VENT® dental implants; may include a hollow basket structure, as in the CORE-VENT® dental implant; or a ledge-type structure, as in the MICRO-VENT® dental implant. Preferably, the body portion is similar to the body portion of the SCREW-VENT® implant. Preferably, such body portions have externally-threaded surfaces with outside/in-

side thread diameters of 3.3 mm/2.8 mm, 3.7 mm/3.2 mm, and 4.7 mm/4.2 mm.

Above the threaded body portion of such implants, optionally, is an unthreaded, preferably cylindrical portion with a diameter that is larger than the inside diameter of, and smaller than the outside diameter of the threads of the body portion. Above the body portion of the unthreaded or hollow basket-type implant is an unthreaded, preferably cylindrical portion with a diameter that approximates the diameter of the body portion. Preferably, the length of this unthreaded portion is up to about 2.0 mm. Complementary surgical drills include score lines to aid in placement of this portion at or below the crest of the jawbone at an implant placement site. If mucosal gum tissue is thicker at such sites than normal (e.g. 2-5 mm thick) at the site, some of this unthreaded portion may be placed above the crest of the placement site, thereby adding to the length of the implant's neck portion.

In preferred embodiments, its neck portion is unthreaded, and is up to about 7.0 mm in length. Preferably, the bottom of this neck portion is substantially the same diameter as the unthreaded portion for a length of up to about 2.0 mm. The neck portion of smaller-diameter implants may then widen, or flare outwardly, preferably over a length of up to about 2.0 mm, to a larger-diameter, cylindrical portion, to support and form an abutment portion on the implant's upper surface. In these embodiments, the neck portion has a straight, cylindrical outer wall of about 1.0 mm in length, leading to an outwardly flaring portion of up to about 4.5 mm in diameter. Alternatively, the neck portion may flare outwardly from the top of the body portion directly to the upper surface, or abutment, portion of the implant, or may be substantially straight for its entire length, depending in part on the diameter of the body portion. The overall length of the neck portion may vary from 2.0 mm to about 7.0 mm to accommodate differences in mucosal gum tissue thickness, and permits surgical placement at or above the top of this tissue.

The neck portion of these new 1-part implants is sufficiently long to project through and above mucosal tissue atop an implant placement site in a patient's jawbone. However, the neck portion does not project so far above this tissue that these implants become exposed to biting forces during the surgical healing period.

In preferred embodiments, the abutment portion includes: (1) an internally-threaded shaft that extends downwardly from the top of the abutment portion into the abutment portion and into the neck portion of the implant; (2) a peripheral wall portion that surrounds, and is spaced from, the opening to the internally-threaded shaft; and, optionally, (3) a wrench-engaging surface such as a hex, or a spline, formed on the inner surface of the peripheral wall portion.

For example, in some embodiments, the abutment portion includes: (1) an internally-threaded shaft that extends downwardly from the top of the abutment portion

into the abutment portion and into the neck portion of the implant; (2) around the opening to the internally-threaded shaft, external wrench-engaging surface; and (3) a peripheral wall portion that surrounds, and is spaced from, the external wrench-engaging surfaces.

These new implants include an internally-threaded shaft extending downwardly from the top of the implant, and terminating inside the implant. This shaft provides an attachment mechanism for retention of a tissue bar which, in turn, supports and retains a removable overdenture. Alternatively, a fixed bridge may also be retained by screws attached to the internally-threaded shaft.

In preferred embodiments, the abutment portions of these new 1-piece implants provide a substantially level platform to allow splinting or other connection of one such implant to another placed in non-parallel common jawbone sites. Such splinting may, for example, be a screw-retained tissue bar.

In preferred embodiments, the abutment portion of these implants includes, on the inner surface of the peripheral shoulder, a multi-sided, multi-faceted or splined, wrench-engaging surface around the opening to the internally-threaded shaft. These wrench-engaging surfaces function to hold, twist or turn the implant, during insertion into the jawbone site or otherwise, and/or as a connector to implant or abutment extensions. Alternatively, the abutment portion includes external or internal wrench-engaging surfaces within, and around, the opening to the internally-threaded shaft.

The wrench-engaging surfaces, internally-threaded shaft, or both, connect to a one-part or multi-part abutment extension, whether ball-shaped, tapered (straight or angled), to be attached to the abutment portion of these implant. Such extensions may provide anti-rotational support, or retention for cemented restorations or overdentures, thus expanding clinical applications.

External wrench-engaging surfaces may be multi-sided, multi-faceted or splined (as, for example, in Calcitek's endosseous, root-form, external spline or Axel Kirsch's endosseous, root-form, internal spline dental implants) projections adapted to hold, twist or turn the implant for insertion, or for connection to multi-part abutment extensions. Such features are preferably located at, and surround, the opening to the internally-threaded shaft. This multi-sided, wrench-engaging feature, preferably with three to eight, and more preferably six, flat sides, projects upwardly from the base of a trepanned hole formed inside a peripheral shoulder.

This external projection is sufficiently long to provide strength for self-tapping insertion of the implant, where the implant has an externally-threaded body portion, or to provide stability for anti-rotational attachment to an abutment extension, or both. The attachment of such an extension lengthens the 1-part implant to facilitate attachment of certain cemented crowns and bridges or overdentures.

The external projection, in embodiments that in-

clude external wrench-engaging facets or sides, is tapered slightly, preferably in the range of about 1 to about 2 degrees, to provide a friction-fit attachment of an extension to the top of the abutment for stable, anti-rotational support of a cemented, single-tooth restoration. See U. S. Patent No. 5,433,606, incorporated herein by reference, for a description of such tapered projections. Preferably, this projection has a length of about 0.5 mm to about 1.5 mm and a diameter in the range of about 2.0 mm to about 3.0 mm, and more preferably about 2.5 mm.

In preferred embodiments, to splint or otherwise connect, by screw retainer, bar prosthesis or otherwise, the implants of this invention which are surgically placed in non-parallel, common jawbone sites, the abutment portion of these implants includes a peripheral shoulder at the top. In preferred embodiments, the wall of the trepanned hole and the external cylindrical wall of the abutment portion form the shoulder. A coping or other prosthetic connector cylinder may be placed on such a shoulder to form a sealed peripheral region, and is thereupon available to be connected to and provide support for a cast bar. This peripheral shoulder may include a chamfered inner edge, a chamfered outer edge, or both. Preferably, these chamfered edges are at the inner edge, form an angle of up to about 45 degrees with the top surface of the shoulder, and provide some lateral stability without interfering with the passive seating of a bar or other connector that splints or otherwise connects a plurality of such implants in non-parallel, common jawbone sites.

In other embodiments, the peripheral shoulder has a flat top surface that tapers downwardly and outwardly from this top surface onto an outer wall surface. Preferably, the taper angle is in the range of about 5 degrees to about 10 degrees, and most preferably about 8 degrees to about 10 degrees.

Preferably, the external wrench-engaging feature lies within a trepanned hole formed by the shoulder to minimize interference with the passive seating of a cast bar or other connector on a plurality of implants in non-parallel sites in a common jawbone. The external projection may, but need not extend above the shoulder, and preferably extends not more than about 0.5 mm above the shoulder, preferably with an overall length of about 0.5 mm to about 1.5 mm, to provide added strength to the feature. This external projection should not project far enough to interfere with seating a cast bar connector on the shoulders of multiple for implants placed in non-parallel sites in a common jawbone. The degree of divergence between two or more such implants may be reduced from up to about 90 degrees to less than about 70 degrees where an external wrench-engaging surface, if any, projects more than 0.5 mm above a peripheral shoulder atop the implant.

In implant embodiments that include an external wrench-engaging projection at the top of the implant, the projection may be tapered outwardly and downwardly

from its upper surface over a length of up to about 0.5 mm. Such tapering facilitates connection of two or more implants in non-parallel, common jawbone sites with up to about 80 degrees of divergence. In addition, the threads in the internally-threaded shaft of such implants preferably begin just below the top of this projection and continue downwardly into the shaft. These threads and the projection, at its preferred height, allow attachment to prosthetic components available for standard hexed abutments sold by Nobelpharma, Implant Innovations, Inc., Core-Vent Corporation and others.

The method of making external wrench-engaging surfaces surrounded by a shoulder atop implants such as those shown in FIGS. 3-6 comprises cutting a notch in the form of a circle atop the implant, and removing the sides of the residual core with the tool shown in FIGS. 7, 8 and 9. This tool comes to a point 100 and has a relief 101 that allows the tool to penetrate into the circular groove to be formed between the external wrench-engaging surfaces and the inner wall of the shoulder, as shown in FIGS 7 and 8. In preferred embodiments, the diameter of relief 101 is about 0.045 inch; the diameter of the drill face, as shown schematically in FIG. 9, is about 0.117 inch.

In preferred embodiments, the abutment portion may include, around the opening to the internally-threaded shaft, a substantially cylindrical projection without external wrench-engaging surfaces. On the inner surfaces of the peripheral wall portion surrounding, and spaced from, this projection, are wrench-engaging surfaces. Illustrative examples of such implants with externally-threaded body portions are shown in FIGS. 17-19 and with externally-unthreaded body portions in FIGS. 20-22. Each of these implants may be used with abutment extenders, as illustratively shown in FIGS. 17-22.

In other alternative embodiments, as shown illustratively, for example, in FIGS. 11-16, the abutment portion of these implants may include an internally-chamfered wall surface on the shoulder portion. In addition, these implant embodiments may include, below the shoulder portion and within the internally-threaded shaft, internal wrench-engaging surfaces. These internal wrench-engaging surfaces may be multi-sided, multi-faceted or splined (as, for example, in Axel Kirsch's internally-splined, endosseous root-form dental implants) and are adapted to hold, twist or turn the implant for insertion or for connection to multi-part abutment extensions. Such features are preferably located at the opening to the internally-threaded shaft and lie entirely within that shaft. This multi-sided, wrench-engaging feature preferably includes three to eight, and more preferably six, flat sides or splines.

Such implants may have externally-threaded body portions, as shown, for example, in FIGS. 11-13, or externally-unthreaded body portions as shown, for example, in FIGS. 14-16. In addition, the neck portion of these implants may be substantially cylindrical over its entire



length, or partly cylindrical and partly flared, as shown, for example, in FIGS. 11 and 14.

The tool shown in FIGS. 7-9 and the method described above for making the implants depicted in FIGS. 3-6, is also useful for forming the shoulder portion and the cylindrical projection within the shoulder portion, as shown, for example, in FIGS. 17-22.

#### BRIEF DESCRIPTION OF THE DRAWINGS

This invention can better be understood by reference to the drawings which are as follows:

**FIG. 1** is a side elevation view of another embodiment of a root-form, one-part endosseous, root-form dental implant having an externally-threaded body portion, a neck portion, and an abutment portion, that includes a peripheral shoulder and, inside said shoulder, upwardly-extending, external wrench-engaging surfaces surrounding an internally-threaded shaft;

**FIG. 2** is a side elevation view of another embodiment of a root-form, one-part endosseous dental implant having an externally-threaded body portion, a neck portion, and an abutment portion that includes external wrench-engaging surfaces in a trepanned hole surrounded by a peripheral shoulder atop the abutment portion of the implant;

**FIG. 3** is a side elevation view of another embodiment of a root-form, one-part endosseous dental implant having an externally-unthreaded body portion, and neck and abutment portions substantially the same as the neck and abutment portions of the implant shown in FIG. 1;

**FIG. 4** is a side elevation view of another embodiment of a root-form, one-part endosseous dental implant having an externally-unthreaded body portion and neck and abutment portions substantially the same as the neck and abutment portions of the implant shown in FIG. 2;

**FIGS. 5-7** show devices and methods for forming external wrench-engaging surfaces and a shoulder atop the implants shown in FIGS. 1-4;

**FIGS. 8-10** show the root-form, one-part endosseous dental implant of FIG. 1 used with abutment extenders;

**FIGS. 11-13** are side elevation views of another embodiment of a root-form, one-part endosseous dental implant having an externally-threaded body portion, a neck portion and an abutment portion that includes a peripheral, chamfered shoulder and, inside said shoulder, internal wrench-engaging surfaces that form part of an internally-threaded shaft;

**FIGS. 14-16** are side elevation views of another embodiment of a root-form, one-part endosseous dental implant having an externally-unthreaded body portion, a neck portion, and an abutment portion that includes a peripheral shoulder and, inside said

shoulder, internal wrench-engaging surfaces forming part of an internally-threaded shaft;

**FIGS. 17-19** are side elevation views of another embodiment of a root-form, one-part endosseous dental implant having an externally-threaded body portion, a neck portion, and an abutment portion that includes a peripheral shoulder and, inside said shoulder, wrench-engaging surfaces formed on the internal wall surface of the shoulder, and an upwardly-extending, substantially cylindrical projection that includes an opening into an internally-threaded shaft;

**FIGS. 20-22** are side elevation views of another embodiment of a root-form, one-part endosseous dental implant having an externally-threaded body portion, a neck portion, and an abutment portion that includes a peripheral shoulder and, inside said shoulder, wrench-engaging surfaces formed on the internal wall surface of the shoulder, and an upwardly-extending, substantially cylindrical projection that includes an opening into an internally-threaded shaft;

**FIGS. 23-25** are side elevation views of another embodiment of a root-form, one-part endosseous dental implant having an externally-unthreaded body portion and substantially the same neck and abutment portions as the implants shown in FIGS. 3 and 4;

**FIGS. 26 and 27** are side elevation views of another embodiment of a root-form, one-part endosseous dental implant having an externally-threaded body portion, a neck portion, and an abutment portion that includes splined wrench-engaging surfaces inside an internally-threaded shaft;

**FIG. 28** shows a top plan view of the implant illustrated in FIG. 26;

**FIG. 29** shows a side elevation view of another embodiment of a root-form, one-part endosseous dental implant having an externally-unthreaded body portion, a neck portion, and an abutment portion that includes splined, internal wrench-engaging surfaces inside an internally-threaded shaft;

**FIG. 30** shows a side elevation view of another embodiment of a root-form, one-part endosseous dental implant having an externally-threaded body portion, a neck portion, and a downwardly, outwardly tapering abutment portion that includes a peripheral shoulder and, inside said shoulder, wrench-engaging surfaces formed on the internal wall surface of the shoulder, and, an upwardly-extending, substantially cylindrical projection that includes an opening into an internally-threaded shaft, shown for use with an abutment extender that has a complementary, tapered mating portion that fits atop the abutment portion of the implant;

**FIG. 31** shows a side elevation view of the implant and abutment extender shown in FIG. 30, with the abutment extender shown in FIG. 30 fitted in place

atop the implant;

**FIG. 32** shows a side elevation view of another embodiment of a root-form, one-part endosseous dental implant shown in FIG. 30, here shown for use with an abutment extender that includes an end portion that fits over the outwardly, downwardly tapering external wall of the abutment portion; and

**FIG. 33** shows a side elevation view of the implant and abutment extender shown in FIG. 32, with the abutment extender shown in FIG. 32 fitted into place atop the abutment portion of the implant.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**FIG. 1** shows 1-part, root-form endosseous dental implant **40** including externally-threaded body portion **41** having, near its distal end, through hole **42** and notch **43** to facilitate self-tapping of implant **40** into an opening formed in a patient's jawbone. Above body portion **41** are cylindrical, unthreaded portion **44**, cylindrical, unthreaded, neck portion **46**, and outwardly-tapering neck portion **47**. Score line **45** separates portion **44** from neck portion **46**. Portions **44** and **46** are both cylindrical-shaped, externally-unthreaded, and of substantially the same diameter as the internal diameter of externally-threaded body portion **41**.

Above neck portion **47** is abutment portion **48** including cylindrical wall **56**. Cylindrical wall **56** includes upper surface **49**. At the inside edge of upper surface **49** is chamfer **50**. Chamfer **50** tapers inwardly and downwardly at an angle of about 45 degrees from upper surface **49**. Below chamfer **50** is internal wall **57**. Internal wall **57**, chamfer **50**, upper surface **49** and cylindrical wall **56** form a peripheral shoulder that surrounds external, multi-sided projection **52**.

Projection **52** has six contiguous flats, e.g. flat **55**, that lie within the peripheral shoulder. Projection **52** includes substantially flat upper surface **53** and tapered surfaces **54** extending downwardly and outwardly from surface **53**. Opening **55** at the center of projection **52** leads into internally-threaded passage **58** which has internal threads **59**. Internal threads **59** extend from just below opening **52** a substantial distance into the interior of the body of the implant, and terminate above the end of passage **58**.

**FIG. 2** shows one-part, root-form, endosseous dental implant **50** having externally-threaded body portion **51**. Near the distal end of body portion **51** are through hole **52** and notch **53**. Notch **53** facilitates self-tapping insertion of implant **50** into an opening formed in a patient's jawbone. Above externally-threaded body portion **51** are cylindrical portion **54**, score line **55**, neck portion **56**, and abutment portion **57**. Portion **54**, neck portion **56**, and abutment portion **57** are all substantially cylindrical in shape, externally-unthreaded, and of substantially the same diameter. Abutment portion **57** includes peripheral shoulder **59** formed by external wall **60**, upper

surface **61**, chamfer **62**, and internal wall surface **65**. Connected to surface **67** within shoulder **59** is external projection **66**. Projection **66** has six flat sides such as sides **68/69/70**. These multi-sided, wrench-engaging surfaces surround the opening into internally-threaded passage **71**. Passage **71** includes internal threads **72**. Internal threads **72** extend from just below upper edge **73** of wrench-engaging surfaces **68/69/70** a substantial distance into internal passage **71** which terminates within implant **50** above externally-threaded body portion **51**. External projection **66** extends approximately 0.5 mm above surface **61** to flat upper surface **73**.

**FIG. 3** shows 1-part, root-form endosseous dental implant **80** having body portion **81**. Body portion **81** includes, near its distal end, through hole **82**. Extending longitudinally along the unthreaded external surface of body portion **81** is longitudinal groove **83** which terminates at the distal end of body portion **81** at through hole **82**. Above body portion **81** are neck portion **82A** and abutment portion **83A**. Score line **84** separates neck portion **82A** from body portion **81**. Neck portion **82A** includes cylindrical portion **85**, and outwardly-tapering portion **84**. Abutment portion **83A** includes cylindrical surface **86**, and substantially flat, tapering upper surface **87**. Internal wall surface **88**, upper surface **87**, internally-chamfered region **89** and external wall surface **86** form peripheral shoulder **90** that surrounds trepanned hole **91**.

In trepanned hole **91** is external wrench-engaging surface **92** that includes a plurality of six flats **93/94/95**. Above these flats are tapered surface **96** and upper surface **97**. Upper surface **97** surrounds the opening into internally-threaded shaft **98** that includes internal threads **99** beginning just below opening **97** and continuing downwardly a substantial distance into internally-threaded shaft **98**.

**FIG. 4** shows one-part, root-form, endosseous dental implant **100** having unthreaded external body portion **101** with longitudinal groove **102** formed in body portion **101**. Groove **102** ends at through hole **103** formed in body portion **101** near the distal end of implant **100**. Above body portion **101** is neck portion **105**. Above neck portion **105** is abutment portion **104**. Abutment portion **104** includes upwardly-projecting, wrench-engaging projection **106** that includes the same features as projection **92** in FIG. 5.

Peripheral shoulder **107** surrounds trepanned hole **108**. Shoulder **107** includes chamfer **109** formed at an angle of about 45 degrees with respect to upper surface **110** of implant **100**.

Internally-threaded shaft **111** includes internal threads **112** that begin near opening **116** that extend downwardly a substantial distance inside implant **100**. Wrench-engaging feature **106** includes six flat, contiguous surfaces, such as flat surfaces **115/113**, and upwardly, inwardly-tapering surface **114**. Projection **113** extends approximately 0.5 mm above top surface **110** of shoulder **107**, permitting implant **100**, and the im-

plants shown in FIGS. 1-3, to be connected to one another by a connector, even where the implants are placed in a common jawbone in non-parallel sites that diverge from one another up to about 90 degrees.

**FIG. 8** shows implant **40** used with abutment extender **200**. Extender **200** includes threaded shank **202** which is screwed into internally-threaded shaft **58** until lower, chamfered, annular-shaped surface **201** seats on upper surface **49**. Extender **200** includes tapered transitional portion **205** and ball joint **203** with internal, multi-sided, wrench-engaging surface **204**.

**FIG. 9** shows implant **40** used with angled, tapered, abutment extender **300**. Extender **300** includes annular, inwardly-chamfered bottom surface **38** that seats on and forms a sealing engagement with upper surface **39**. With surface **38** seated on upper surface **49**, internal wrench-engaging surfaces **303** engage the flats, such as flat **304**, of external projection **52**. Extender **300** includes tapered angle surface **307** and opening **301**. Screw **302** passes through opening **301**, engages threads **309** and internal threads **58** of implant **40**. Head **305** of screw **302** seats on surface **309**, and functions to hold extender **300** onto implant **40**.

**FIG. 10** shows implant **40** used with abutment extender **400**. Extender **400** includes lower, annular, internally-chamfered surface **407** that seats on and forms a sealing engagement with upper surface **49**. When lower surface **407** is seated on upper surface **49**, internal wrench-engaging surfaces **402** engage flats such as flat **304** of projection **52** on implant **40**. With extender **400** seated on implant **40**, screw **405** is inserted through opening **401**, and screws into threads **408** of extender **400** and into internal threads **58** of implant **40**. Head **404** of screw **405** thereupon engages upper surface **409** inside extender **400** to hold extender **400** onto implant **40**. External tapered surface **406** is used for connection to dental prostheses and other dental connectors.

**FIGS. 11 and 12** show root-form, one-part endosseous dental implant **500** including externally-threaded body portion **501**, unthreaded, substantially cylindrical neck portion **502/508**, outwardly-flared neck portion **507**, and abutment portion **503**. Abutment portion **503** includes a shoulder portion having flat upper surface **523** contiguous with downwardly, internally-extending, chamfered region **504**. The shoulder portion surrounds opening **524** into internally-threaded shaft **510** that includes internal threads **511** and multi-sided, wrench-engaging surfaces such as surfaces **505/506**. Through-hole **509** includes self-tapping threads to facilitate placement of this implant in a jawbone site.

Above implant **500** in **FIG. 11** is one-piece abutment extender **512**. Extender **512** includes threaded shank **513**, integrally-formed seating portion **515** that seats sealingly on surface **523**, and upwardly-projecting, integrally-formed ball connector **525** with internal multi-sided, wrench-engaging surfaces **514**.

In **FIG. 12**, implant **500** is shown for use with two-part abutment **517** including angled extender part **526**

with integrally-formed, multi-sided projection **516** that fits into internal, wrench-engaging surfaces **508/506**. Extender part **526** includes internal, longitudinally-extending passage **527** having internal threads **522**. Bolt member **528** fits into passage **527** with internal threads **519** passing through threads **522** and engaging threads **511** in internally-threaded shaft **510** of implant **500**. Cap portion **520** engages surface **521** to hold abutment extender part **526** firmly in place atop implant **500**. Extender part **526** includes chamfered surface **529** that sealingly seats on chamfered surface **504**.

**FIG. 13** shows root-form, one-part endosseous dental implant **600** having externally-threaded body portion **602**, through-hole **603** that passes through self-tapping cutter region **615**. Above externally-threaded body portion **602** is neck portion **601/604**. Atop neck portion **601/604** is abutment portion **605** that forms a shoulder including flat upper surface **616** and internally-chamfered, downwardly-extending, internal surface **617**. Two-part abutment extender **618** includes first part **619** having downwardly-projecting, multi-sided projection **608** that fits into and engages, anti-rotationally, the flat surfaces of multi-sided, internal wrench-engaging surfaces **607/606**. Longitudinal passage **618** through abutment extender **619** receives extender screw **612**. Extender screw **612** includes threaded shank **611** that passes through internally-threaded portion **614** and engages internal threads **621** in internally-threaded passage **622** inside implant **600**. Cap member **612** on screw **620** includes bottom surface **624** that engages surface **623** inside passage **618** to hold abutment extender part **619** firmly atop implant **600**. Extender **619** includes, around projection **608**, chamfered surface **624** that fits within chamfered surface **617** atop implant **600**, forming sealing engagement with implant **600**.

**FIGS. 14, 15 and 16** show root-form, one-part endosseous dental implants **700** and **700A**. Each of these implants include unthreaded, cylindrical body portion **701** with through-hole **711** forming near the apical end of the implant. Each of these implants included internally-threaded shaft **709** with internal threads **710**. Each of these implants includes neck portion **702**. The implant shown in **FIG. 14** also includes neck portion **703** that flares outwardly. The implants in **FIGS. 15 and 16** include neck portion **703A** that is substantially the same in diameter as neck portion **702**. Each of the implants also includes abutment portion **704** that includes in flat upper surface **706** on a shoulder formed, in part, by internally-chamfered, downwardly-extending surface **705**. Internal wrench-engaging surfaces **707/708** are part of internally-threaded shaft **709**.

The implant of **FIG. 14** is shown with one-part abutment extender **720**. Extender **720** includes threaded shank **721**, sealing surface **722**, and upward projection **723** with internal wrench-engaging surfaces **724**. Abutment extender **720** screws into internal threads **710** with surface **722** seating on surface **705** to form sealing engagement between extender **720** and implant **700**.



In FIG. 15, implant **700A** is shown for use with abutment extender **730**. Abutment extender **730** includes tapered sidewall surfaces **750/751** and internal longitudinal passage **732**. Passage **723** receives abutment extender screw **733** with its threaded shank **735** and cap member **734**. Cap member **734** includes flat bottom surface **737** that engages flat surface **738** to hold abutment extender **730** firmly to implant **700A**. Chamfered surface **752** is complementary in size and shape to internally-chamfered surface **705** and seats firmly and sealingly in surface **705** when abutment extender **730** is in place atop implant **700A**, as FIG. 15 shows. Multi-sided projection **731** fits into internal wrench-engaging surfaces **707/708** of implant **700A** to prevent rotation of the abutment extender with respect to implant **700A**.

FIG. 16 shows abutment **700A** used with abutment extender **740**. Abutment extender **740** includes inwardly-tapered external surface **741** and multi-sided projection **743** that engages flat internal wrench-engaging surfaces **707/708**. Extender **740** includes internally-threaded passageway **744** through which threaded shank **747** of abutment screw **745** passes. Cap member **746** on screw **745** engages the surfaces surrounding the opening to threaded passage **744** when the threads of shank **742** engage internal threads **710** in internally-threaded passage **709**. Chamfered surface **748** on extender **740** seats firmly in internally-chamfered surface **707** of abutment portion **704**.

FIGS. 17, 18 and 19 show root-form, one-part endosseous dental implant **800** having externally-threaded body portion **801** that includes, near its distal end, apical longitudinal opening **813** and self-tapping cutter **814**. Atop body portion **800** is cylindrical neck portion **802/803** and outwardly-flaring neck portion **804**. Above neck portion **802/803/804** is abutment portion **805** formed by external shoulder **812**. Shoulder **812** has flat surface **806** at the top and internally-chamfered region **807** formed at the internal edge of flat surface **806**. Shoulder **812** surrounds a hole within which substantially cylindrical, externally-unthreaded projection **808** extends upwardly and above flat surface **806**. At the top of projection **808** is opening **815** to internally-threaded passage **809** having internal threads **810**. Projection **808** projects above upper surface **806** a distance sufficient to permit interconnection of a plurality of these implants placed in diverging, non-parallel sites in a common jawbone.

In FIG. 17, abutment **800** is shown for use with abutment extender **816**. Extender **816** includes threaded shank **820** that engages internal threads **810** in internally-threaded passage **809** of implant **800**. With extender **816** seated atop implant **800**, chamfered surface **817** at the edge of extender **816** seats on flat surface **806** and internally-chamfered surface **807** of implant **800**. Extender **817** includes ball connector **818** with internal wrench-engaging surfaces **819**.

In FIG. 18, implant **800** is shown for use with abutment extender **821**. Extender **821** includes upwardly-tapered surfaces **822/823** and downwardly-projecting,

multi-sided projection **831** that fits into internal, multi-sided, wrench-engaging surface **811** formed on the inner wall of shoulder **812**. Projection **831** and inner wall surface **811** have the same number of contiguous flat surfaces and engage one another anti-rotationally with extender **821** seated on implant **800**.

Extender **821** is held to implant **800** with screw **828** that includes threaded shank **829** and cap portion **830**. Threaded portion **829** screws through internal threaded portion **825** and internal passage **824** of extender **821**. The bottom of cap portion **830** seats on surface **827** inside extender **821**, holding extender **821** firmly atop implant **800**. With extender **821** seated atop implant **800**, chamfered surface **826** seats firmly on chamfered surface **807** of implant **800**.

FIG. 19 shows implant **800** used with abutment extender **833**. Extender **833** includes upwardly-inwardly-tapering surface **834** and downwardly-projecting, multi-sided projection **832**. Projection **832** includes the same number of contiguous flat surfaces as on wrench-engaging surface **811**, formed on the inner wall surface of shoulder **812**. Thus, extender **834** seats anti-rotationally by engagement of multi-sided projection **832** with multi-sided surface **811** on implant **800**. Extender **833** is held to implant **800** with screw **838** that includes threaded shank **840** and cap portion **839**. Threaded portion **840** screws through internal threaded portion **836** in longitudinal passage **835** and extender **833**. Bottom surface of cap portion **839** seats on surface **837**, holding extender **833** firmly on implant **800**. With extender **833** seated atop implant **800**, chamfered surface **841** seats on flat surface **806** and chamfered surface **807** to form sealing engagement between implant **800** and extender **833**.

FIGS. 20, 21 and 22 each show root-form, one-part, externally-unthreaded endosseous dental implant **900** with unthreaded body portion **901** and, near the apical end of body portion **901**, through-hole **902**. Body portion **901** also includes longitudinal groove **930**. There may be a plurality of such grooves spaced, preferably equidistantly, around the circumference of body portion **901**. Atop body portion **901** are neck portions **903/904** of substantially the same diameter and circumference as body portion **901**. Atop neck portion **903/904** is abutment portion **905** formed by external, cylindrical, unthreaded wall surface **913** and internal, multi-sided wall surface **912**. Inside wall surface **913** is trepanned hole **914**. Extending upwardly from the bottom of trepanned hole **914** is substantially cylindrical and externally-unthreaded projection **908**. Projection **908** projects above flat surface **906** at the top of implant **900** and above internally-chamfered surface **907** that extends downwardly and inwardly from flat surface **906** toward projection **908**. Projection **908** has, at its top, opening **909** into internally-threaded passage **910** with internal threads **911**. Projection **908** extends above flat surface **906** a distance sufficient to connect, as by splinting, a plurality of these implants placed in diverging sites in a common jawbone.



The implant of FIG. 20 is shown for use with abutment extender **816**. Extender **816** includes threaded shank **820** that screws into internal threads **911** of internally-threaded passage **910**. With extender **816** seated firmly atop abutment **900**, chamfered surface **817** mates with and forms sealing engagement with flat surface **906** and chamfered surface **907** of implant **900**. Extender **816** includes ball connector **818** with internal wrench-engaging surfaces **819**.

In FIG. 21, implant **900** is shown for use with abutment extender **821**. Extender **821** includes downwardly-projecting, multi-sided projection **831** with the same number of contiguous flat sides as internal surface **912** of implant **900**. With abutment extender **821** seated atop implant **900**, surface **826** forms sealing engagement with internally-chamfered surface **906** and upper flat surface **906**. Longitudinal passage **824** through extender **821** includes threaded region **825**. Extender screw **828** includes threaded shank **829** and cap portion **830**. When screwed into internal threads **825** of extender **821** and then into internal threads **911** of implant **900**, abutment extender screw **828** holds abutment extender **821** firmly atop implant **900**.

FIG. 22 shows implant **900** for use with abutment extender **833**. Extender **833** includes downwardly-projecting, multi-sided projection **832** that has the same number of flat contiguous sides as internal, wrench-engaging surface **912**. With extender **833** seated atop implant **900**, surface **841** seats firmly against internally-chamfered surface **907** and flat surface **906** of implant **900**. Extender screw **833** includes threaded shank **840** and cap portion **839**. Screw **838** screws into threads **836** inside extender **833** and then into internal threads **911** of internal passage **911** through opening **909**, and holds extender **833** firmly atop implant **900**.

FIGS. 23, 24 and 25 show root-form, one-part endosseous dental implant **1000** with externally-unthreaded body portion **1001**. Body portion **1001** includes one or more external, longitudinally-extending grooves **1002** and through-hole **1003**. Atop body portion **1001** is neck portion **1004/1005**. Atop neck portion **1004/1005** is abutment portion **1006**. Atop abutment portion **1006** is flat surface **1007** and, extending inwardly and downwardly from surface **1007**, internally-chamfered surface **1008**. External, multi-sided projection **1009** projects upwardly from the hole formed by shoulder **1013**. External projection **1010** is substantially the same in size, shape and dimensions as external projection **114** in FIG. 4 and projection **96** in FIG. 3.

In FIG. 23, implant **1000** is shown for use with abutment extender **200**, which includes threaded shank **202** for threaded engagement with internal threads **1012** and internally-threaded passage **1011** of implant **1000**. When fully seated atop implant **1000**, surface **201** of extender **200** forms sealing engagement with surfaces **1007/1008** of implant **1000**.

FIG. 24 shows implant **1000** for use with abutment extender **300**. Extender **300** includes internal, multi-sided

ed wrench-engaging surfaces **303** that seat themselves on complementary, multi-sided surfaces of projection **1009**. Extender **300** is held firmly atop implant **1000** by screw **302**. Screw **302** includes threaded shank **306** that threads through internal threads **309** and into threads **1012** of internal passage **1011**. Cap member **305** seats itself on the shelf surrounding internally-threaded passage **309**, holding the extender in place atop implant **1000**.

In FIG. 25, implant **1000** is shown for use with abutment extender **400**. Extender **400** includes the same parts and features as extender **400** shown in FIG. 10. Extender **400** includes internal, multi-sided wrench-engaging surfaces **402** that engage with the external, multi-sided surfaces of projection **1009** atop implant **1000**. Extender **400** is held firmly atop implant **1000** by means of screw **405**. Screw **405** includes threaded shank **406** that threads through internal threads **408** and into threads **1012** of internally-threaded passage **1011**. Cap member **404** holds externally-threaded screw **405** onto surface **409** which, in turn, holds extender **400** firmly atop implant **1000**. With abutment extender **400** seated atop implant **1000**, chamfered surface **407** forms sealing engagement with internally-chamfered surface **1008** and upper flat surface **1007**.

FIG. 26 shows root-form, one-part endosseous dental implant **1100** having externally-threaded body portion **1101**, through-hole **1102** formed near the apical end of body portion **1101**, in self-tapping threads. Above threaded body portion **1101** are substantially cylindrical neck portions **1103/1104**, and outwardly-flared neck portion **1105**. Atop neck portion **1105** is abutment portion **1106** that includes flat upper surface **1107** and inwardly-chamfered surface **1108** forming a peripheral shoulder. Inwardly-chamfered surface **1108** surrounds the opening to internally-threaded shaft **1111** that includes internal threads **1112**. Internally-threaded shaft **1111** also includes, near opening **1116**, splined, wrench-engaging surfaces **1109/1110**.

Abutment extender **1114** includes male, splined projection **1113** that fits into and interlocks with internal splines **1109/1110**. Extender **1114** is held firmly atop implant **1100** by means of screw **1115** which screws through extender **1114** and into internal threads **1112**.

FIG. 28 shows a top plan view of the splined, wrench-engaging surfaces of implant **1100** as seen through opening **1116**.

FIG. 27 shows root-form, one-part endosseous dental implant **1200** that includes externally-threaded body portion **1201** and through-hole **1202**. Atop threaded body portion **1201** are neck portions **1203/1204** and abutment portion **1205**. Abutment portion **1205** includes flat upper surface **1206** and internally-chamfered surface **1207**, forming a peripheral shoulder. Inwardly-chamfered surface **1207** surrounds opening **1214** to internally-threaded shaft **1212** that includes internal threads **1213**. Just below opening **1214** and inside internally-threaded shaft **1212** are splined, wrench-en-

gaging surfaces **1208/1209**. Surfaces **1208/1209** receive and engage splined projection **1211** on abutment extender **1210**.

Abutment extender **1210** is held to implant **1200** by means of threaded abutment screw **1215** which screws through extender **1210** and into internal threads **1213** of implant **1200**.

**FIG. 29** shows root-form, one-part endosseous dental implant **1300** that includes externally-unthreaded, cylindrical body portion **1301**, apical through-hole **1302** and longitudinally-extending groove **1303**. Atop threaded body portion **1301** are neck portions **1304/1305**. Atop neck portions **1304/1305** is abutment portion **1306** that includes flat upper surface **1307** and inwardly-extending, chamfered surface **1308** forming a shoulder portion. Surface **1308** surrounds opening **1316** into internally-threaded shaft **1311** that includes internal threads **1312**. Just inside and below opening **1316** are splined, internal, wrench-engaging surfaces **1309/1310**. Abutment extender **1313** includes splined projection **1314** that fits into and interlocks with splined internal wrench-engaging surfaces **1309/1310**.

Abutment extender **1313** is held to implant **1300** by means of extender screw **1313** which screws through the internal threads of extender **1313** and into internal threads **1312** of implant **1300**.

**FIG. 30** shows a side elevation view of root-form, one-part endosseous dental implant **1400** having externally-threaded body portion **1401**. Implant **1400** includes upwardly extending projection **1406** with an opening leading to internally-threaded shaft **1429** that includes internal threads **1430**. Above externally-threaded body portion **1401** are neck portion **1402** and abutment portion **1403**. Abutment portion **1403** includes flat upper surface **1424** and internal wall surface **1425** and external wall surface **1404**. Wall surface **1425** includes multi-sided, wrench-engaging surfaces. Surface **1404** tapers outwardly and downwardly from flat surface **1424** at an angle of approximately 8 degrees with respect to the plane in which surface **1424** lies.

**FIG. 30** shows implant **1400** used with abutment extender **1426**. Extender **1426** includes outwardly, downwardly tapering external surface **1407** terminating at ledge portion **1427**. Extender end portion **1408** is cylindrical in shape, may taper inwardly and downwardly, if desired, to form a friction fit with wall surface **1425**, and has a size and shape sufficient to fit into the trepanned hole formed between upwardly extending projection **1428** and internal wall surface **1425**. Extender **1426** includes cavity **1409** that has a size and shape sufficient to fit over projection **1428**.

As **FIG. 31** shows, with extender **1426** fitted into the trepanned hole between projection **1428** and internal wall surface **1425**, abutment extender surface **1407** mates with and forms a flush, continuous surface with downwardly, outwardly tapering external wall surface **1404**. Abutment extender screw **1420** screws through internal threads **1421** in extender **1426**, and into internal

threads **1430** in internally-threaded shaft **1429** to hold extender **1426** in place atop implant **1400**.

The combination of implant **1400** with abutment extender **1426**, as shown in **FIG. 31**, permits attachment of a prosthesis, e.g. a false tooth, that extends below juncture line **1431** between extender **1426** and implant **1400**. As a result, the prosthesis extends below mucosal tissue atop the implant, producing a natural profile to the restoration, and an aesthetically-pleasing appearance upon restoration. For example, a false tooth may be formed from the bottom of external wall surface **1404**, covering and protecting juncture line **1431**.

**FIG. 32** shows the same root-form, one-part endosseous dental implant **1400** shown in **FIGS. 30** and **31**. As in **FIGS. 30** and **31**, implant **1400** includes abutment portion **1403**. Abutment portion **1403** includes flat upper surface **1424**, internal wall surface **1425** with multi-sided, wrench-engaging surfaces, and external wall surface **1404**. Surface **1404** tapers outwardly and downwardly from flat surface **1424** at an angle of approximately 8 degrees with respect to the plane in which surface **1424** lies.

**FIG. 32** shows implant **1400** used with implant extender **1440**. Extender **1440** includes body portion **1442**, central longitudinal opening **1445**, internally-threaded region **1444**, and, at its bottom end, annular cavity **1441**.

As **FIG. 33** shows, with abutment extender **1440** fitted atop implant **1400**, abutment portion **1403** fits into annular cavity **1441** which overlies external wall surface **1404**. Abutment extender screw **1443** threads through internally-threaded region **1444** of abutment extender **1440** and into internal threads **1430** in internally-threaded shaft **1429** to hold abutment extender **1440** firmly atop implant **1400**. Since abutment extender **1440** is of sufficient size to fit over the peripheral shoulder formed by external wall **1404**, internal wall **1425** and upper surface **1424** atop implant **1400**, extender **1440** can be trimmed to better accommodate angulation and parallelism requirements for prostheses to be attached to the combination of implant **1400** and extender **1440**. The size and shape of extender **1444** is adequate to create a natural profile in a wide tooth restoration such as a molar.

## Claims

1. A one-part, endosseous, root-form dental implant including:

a body portion for insertion into an opening in the jawbone of a patient;  
a neck portion formed above said body portion, said neck portion projecting above said body portion a sufficient length to project through mucosal tissue above said jawbone opening;  
an abutment portion formed above said neck portion, said abutment portion including a pe-

- peripheral shoulder projecting upwardly at the top of said implant to support attachment of a connector for at least two such implants placed in non-parallel, common jawbone sites;  
 an internally-threaded shaft extending downwardly into said implant from the top surface of said implant; and  
 surrounding the opening to said internally-threaded shaft, external wrench-engaging surfaces forming a projection lying in a hole formed by said shoulder.
2. The implant of claim 1 wherein the top of said abutment portion has a size and shape adapted to form a sealed margin with a prosthetic attachment.
  3. The implant of claim 1 or claim 2 wherein said projection extends above the upper surface of said shoulder, and said projection tapers downwardly and outwardly from a flat upper surface to provide friction-fit connection to a female abutment extender.
  4. The implant of claim 3 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion.
  5. The implant of claim 1 or claim 2 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion.
  6. The implant of claim 1 or claim 2 wherein said external wrench-engaging surfaces have from 4 to 8 flat, contiguous sides, a flat upper surface, and tapering surfaces extending downwardly from said upper surface to said flat, contiguous sides.
  7. The implant of claim 1 or claim 2 further comprising an abutment extender that has a lower surface adapted to seat on and form a sealing engagement with said peripheral shoulder.
  8. The implant of claim 6 further comprising an abutment extender that has a lower surface adapted to seat on and form a sealing engagement with said peripheral shoulder.
  9. A one-part, endosseous, root-form dental implant including:
 

a body portion for insertion into an opening in the jawbone of a patient;
- a neck portion formed above said body portion, said neck portion projecting above said body portion a sufficient length to project through mucosal tissue above said jawbone opening;  
 an abutment portion formed above said neck portion, said abutment portion including a peripheral shoulder projecting upwardly at the top of said implant to support attachment of a connector for at least two such implants placed in non-parallel, common jawbone sites;  
 an internally-threaded shaft extending downwardly into said implant from the top surface of said implant;  
 surrounding the opening to said internally-threaded shaft, an externally-unthreaded, substantially cylindrical projection lying in a hole formed by said shoulder; and  
 on the inner surface of said shoulder, multi-sided wrench-engaging surface.
10. The implant of claim 9 wherein the top of said abutment portion has a size and shape adapted to form a sealed margin with a prosthetic attachment.
  11. The implant of claim 9 or claim 10 wherein said projection extends above the upper surface of said shoulder, and said projection tapers downwardly and outwardly from a flat upper surface to provide friction-fit connection to a female abutment extender.
  12. The implant of claim 11 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion.
  13. The implant of claim 9 or claim 10 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion.
  14. The implant of claim 9 or claim 10 wherein said wrench-engaging surfaces have from 4 to 8 flat, contiguous sides, or a plurality of splines.
  15. The implant of claim 9 or claim 10 further comprising an abutment extender that has a lower surface adapted to seat on and form sealing engagement with said peripheral shoulder.
  16. The implant of claim 11 further comprising an abutment extender that has a lower surface adapted to seat on and form a sealing engagement with said peripheral shoulder.



17. A one-part, endosseous, root-form dental implant including:

a body portion for insertion into an opening in the jawbone of a patient; 5  
 a neck portion formed above said body portion, said neck portion projecting above said body portion a sufficient length to project through mucosal tissue above said jawbone opening;  
 an abutment portion formed above said neck portion, said abutment portion including a peripheral shoulder projecting upwardly at the top of said implant to support attachment of a connector for at least two such implants placed in non-parallel, common jawbone sites; 10  
 an internally-threaded shaft extending downwardly into said implant from the top surface of said implant; and  
 near the opening to and within said internally-threaded shaft, internal wrench-engaging surfaces. 20

18. The implant of claim 17 wherein the top of said abutment portion has a size and shape adapted to form a sealed margin with a prosthetic attachment. 25

19. The implant of claim 17 or claim 18 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion. 30

20. The implant of claim 17 or claim 18 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion. 35 40

21. The implant of claim 17 or claim 18 wherein said internal wrench-engaging surfaces have from 4 to 8 flat, contiguous sides, or a plurality of splines. 45

22. The implant of claim 17 or claim 18 further comprising an abutment extender that has a lower surface adapted to seat on and form a sealing engagement with said peripheral shoulder. 50

23. A one-part, endosseous, root-form dental implant including:

a body portion for insertion into an opening in the jawbone of a patient; 55  
 a neck portion formed above said body portion, said neck portion projecting above said body

portion a sufficient length to project through mucosal tissue above said jawbone opening;  
 an abutment portion formed above said neck portion, said abutment portion including a peripheral shoulder projecting upwardly at the top of said implant to support attachment of a connector for at least two such implants placed in non-parallel, common jawbone sites; and  
 an internally-threaded shaft extending downwardly into said implant from the top surface of said implant.

24. The dental implant of claim 23 wherein the top of said abutment portion has a size and shape adapted to form a sealed margin with a prosthetic attachment.

25. The implant of claim 23 or claim 24 wherein said body portion is externally-threaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion.

26. The implant of claim 23 or claim 24 wherein said body portion is externally-unthreaded, said neck portion includes a substantially cylindrical portion contiguous with said neck portion, and an outwardly flaring portion atop said substantially cylindrical portion, and said shoulder is atop said outwardly flaring portion.

27. The implant of claim 23 or claim 24 further comprising an abutment extender that has a lower surface adapted to seat on and form a sealing engagement with said peripheral shoulder.

28. The implant of claim 1 or claim 9 or claim 17 or claim 23 wherein said peripheral shoulder includes an external wall surface that tapers downwardly and outwardly from the top surface of said peripheral shoulder.

29. The implant of claim 28 wherein said external wall surface forms an angle with respect to said top surface in the range of about 5 degrees to about 10 degrees.

30. A one-part, endosseous, root-form dental implant including:

a body portion for insertion into an opening in the jawbone of a patient;  
 a neck portion formed above said body portion, said neck portion projecting above said body portion a sufficient length to project through mucosal tissue above said jawbone opening;

an abutment portion formed above said neck portion, said abutment portion including a peripheral shoulder projecting upwardly at the top of said implant to support attachment of a connector for at least two such implants placed in non-parallel, common jawbone sites; 5  
an internally-threaded shaft extending downwardly into said implant from the top surface of said implant; and  
surrounding the opening to said internally-threaded shaft, external wrench-engaging surfaces. 10

31. A one-part, endosseous, root-form dental implant including: 15

a body portion for insertion into an opening in the jawbone of a patient;  
a neck portion formed above said body portion, said neck portion projecting above said body portion a sufficient length to project through mucosal tissue above said jawbone opening; 20  
an abutment portion formed above said neck portion, said abutment portion including a peripheral shoulder projecting upwardly at the top of said implant to support attachment of a connector for at least two such implants placed in non-parallel, common jawbone sites; 25  
an internally-threaded shaft extending downwardly into said implant from the top surface of said implant; 30  
surrounding the opening to said internally-threaded shaft, an externally-unthreaded, substantially cylindrical projection; and  
on the inner surface of said shoulder, multi-sided wrench-engaging surface. 35

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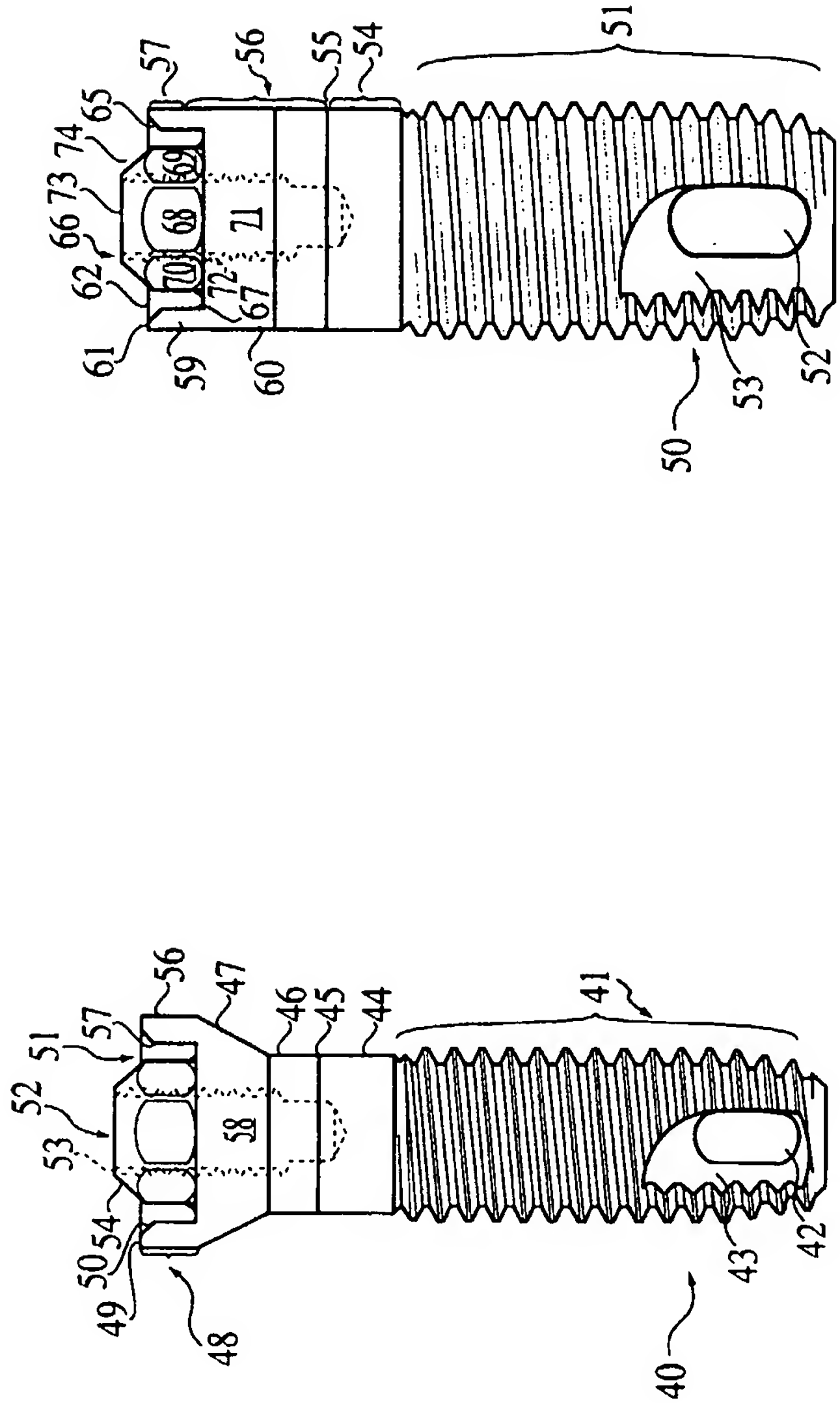


FIG. 1

FIG. 2



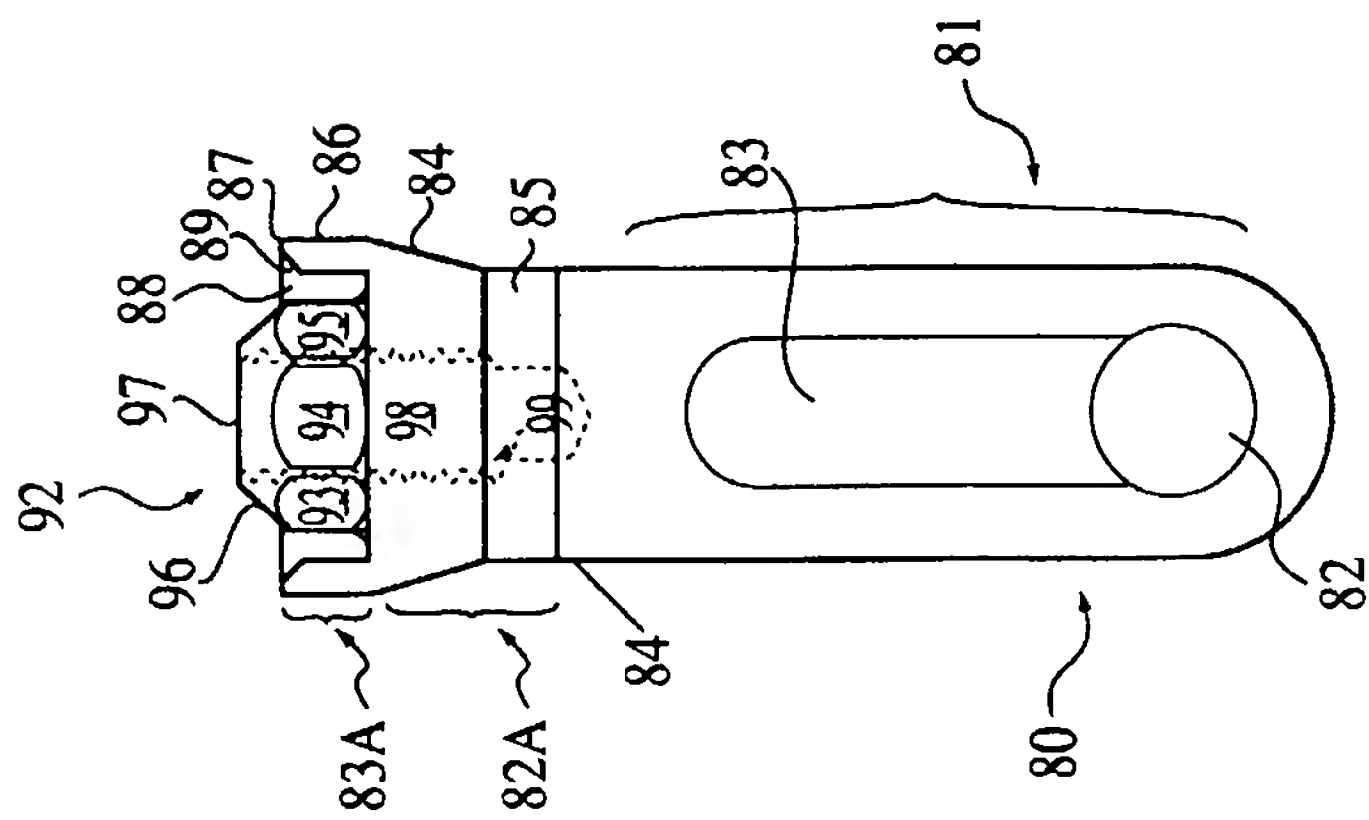


FIG. 3

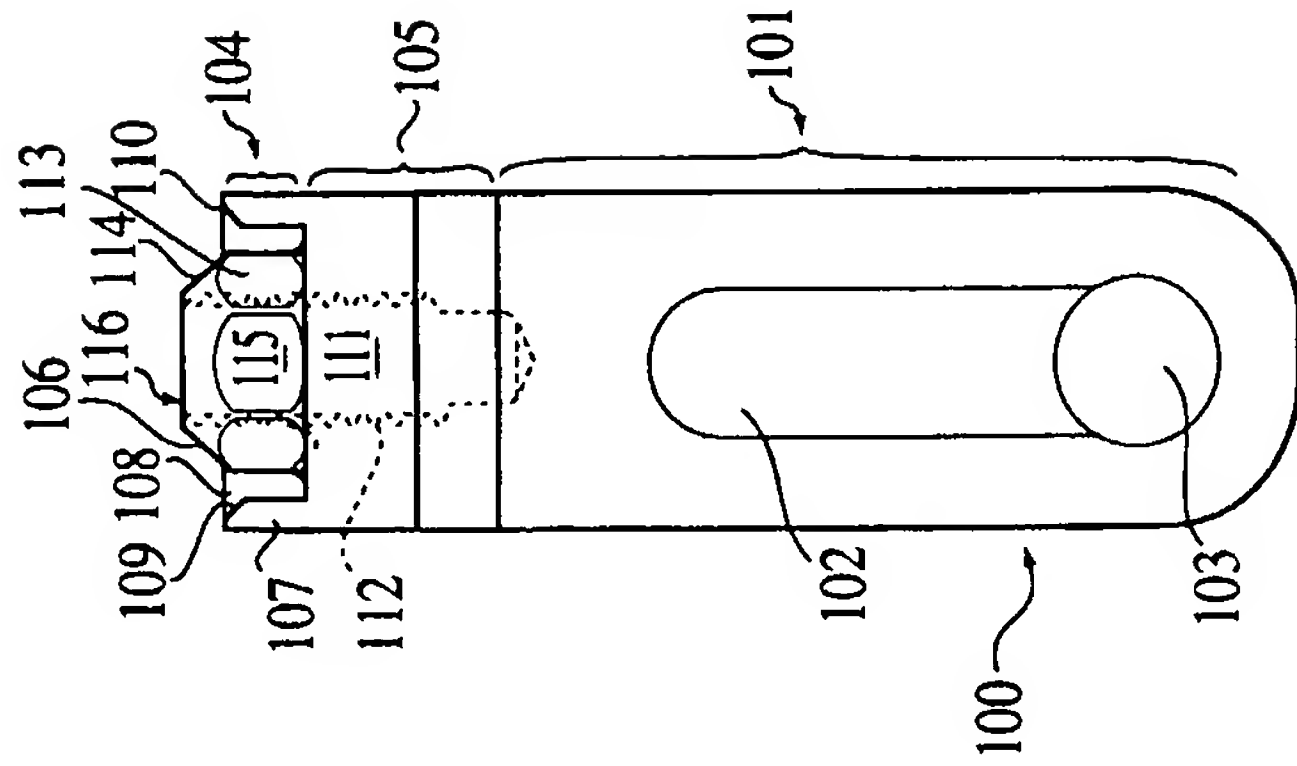


FIG. 4

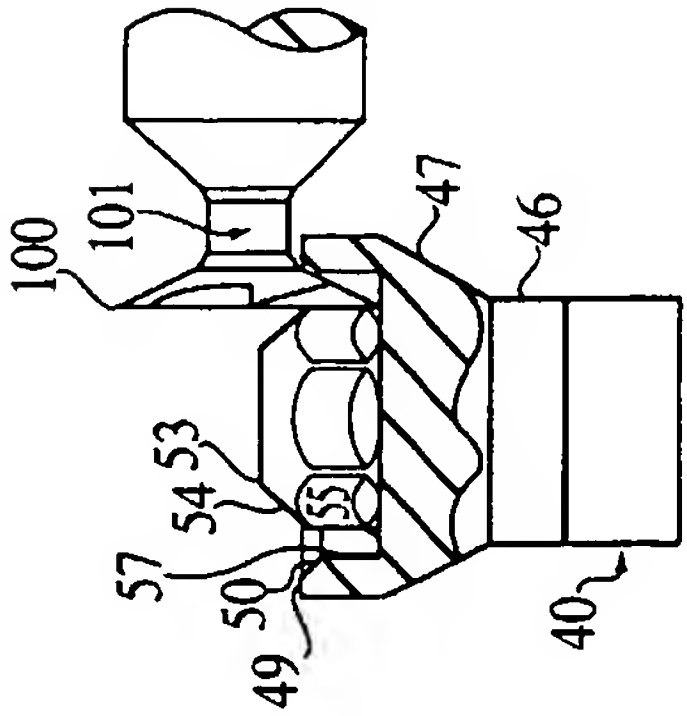


FIG. 5

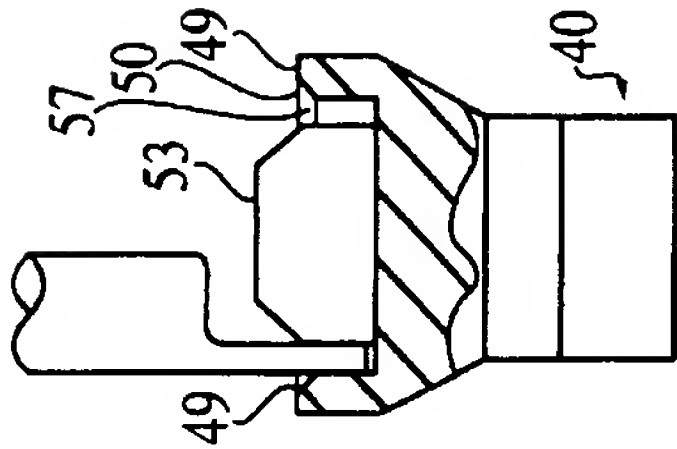


FIG. 6

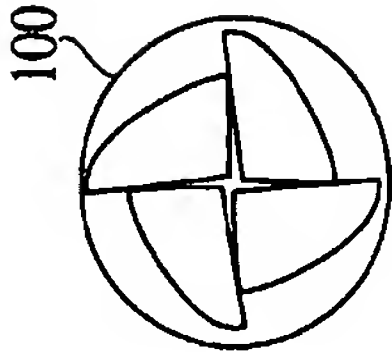
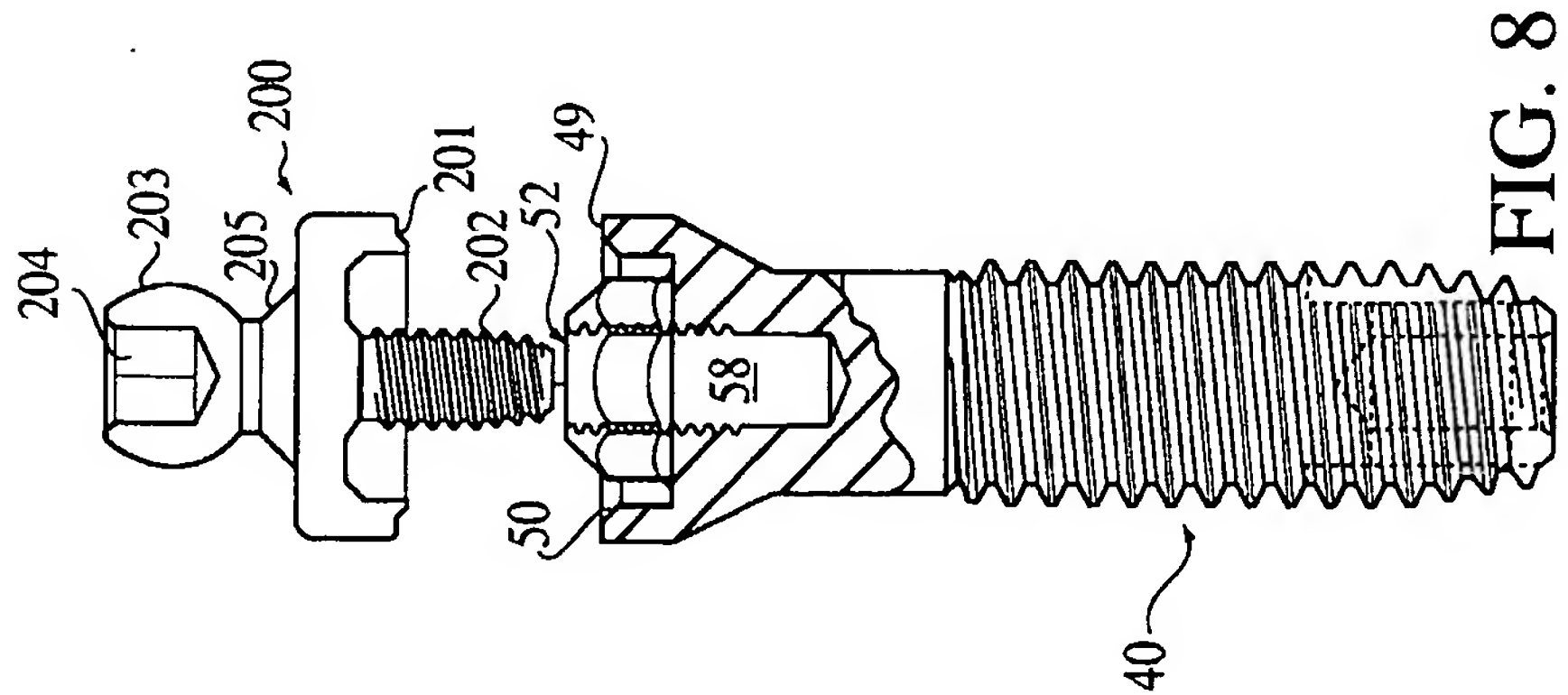
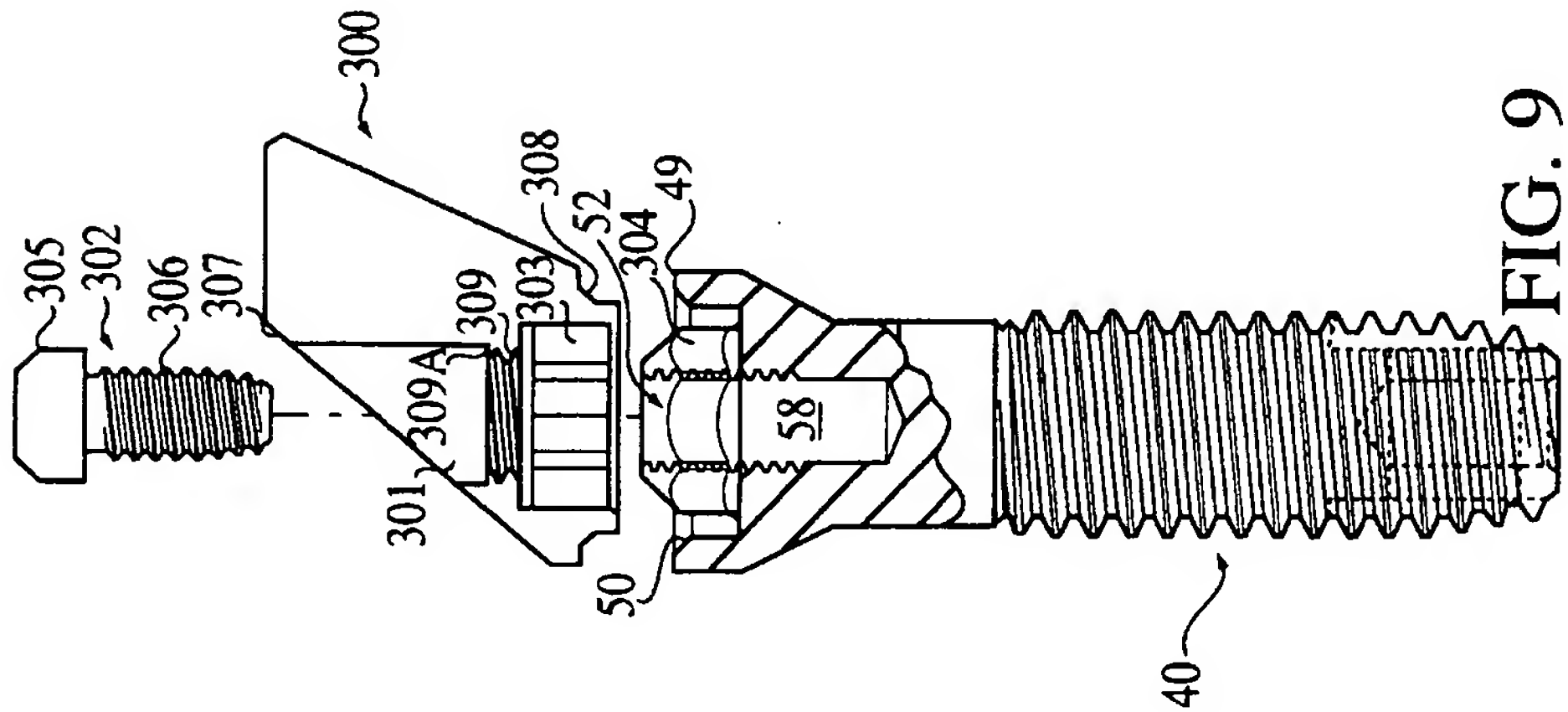
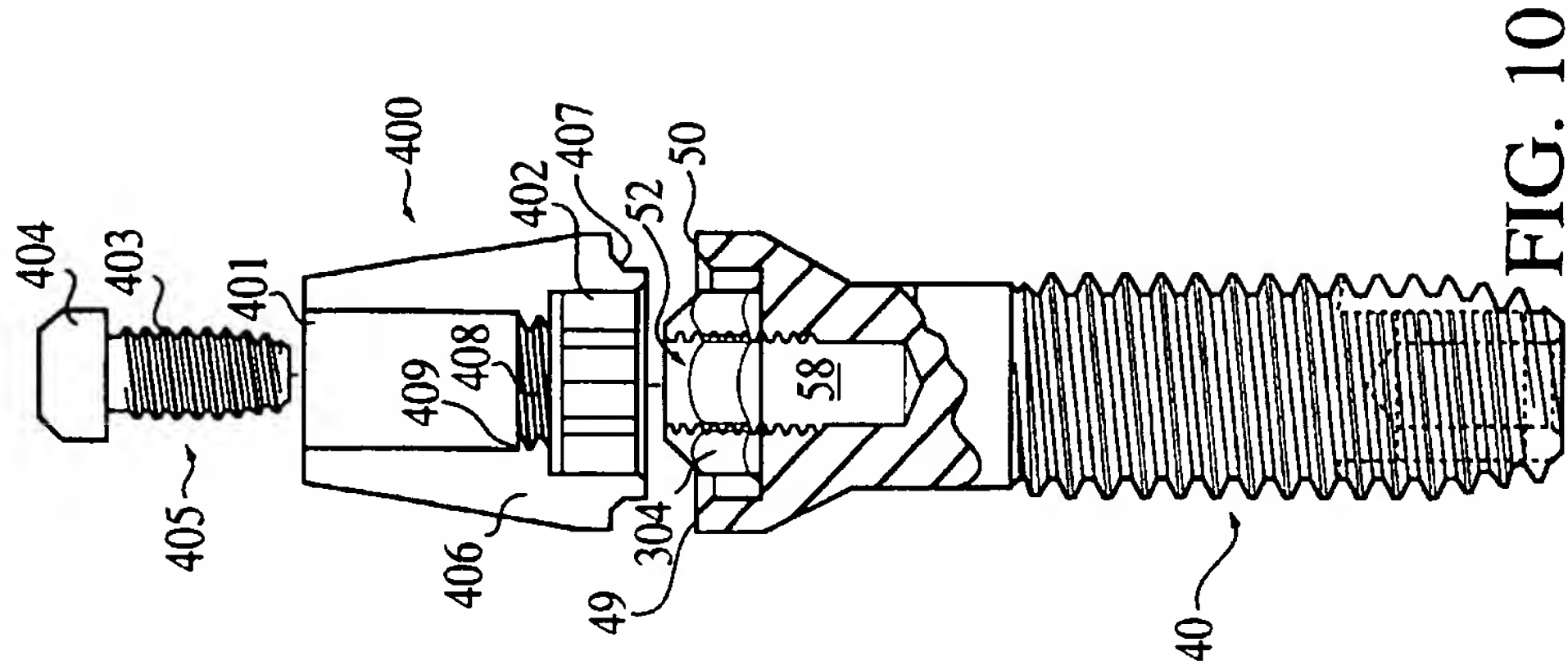
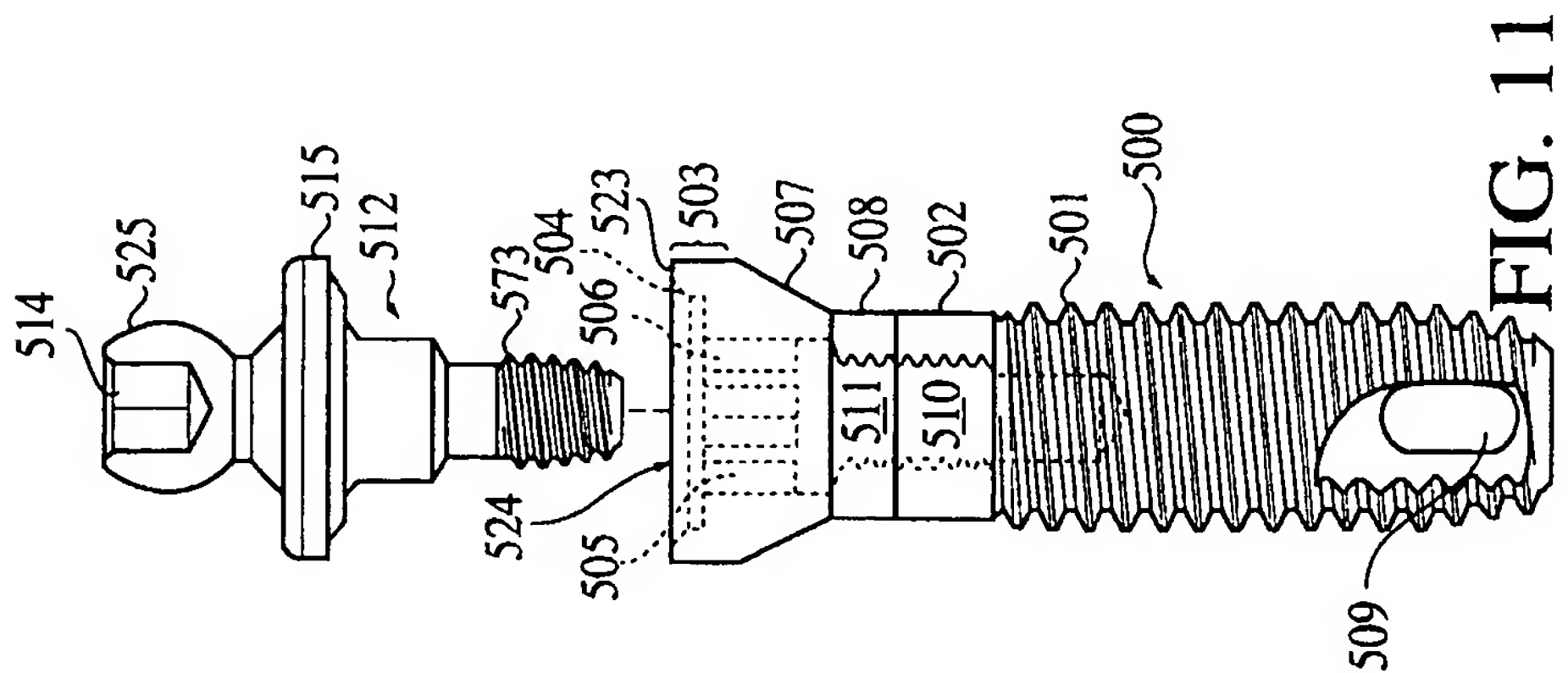
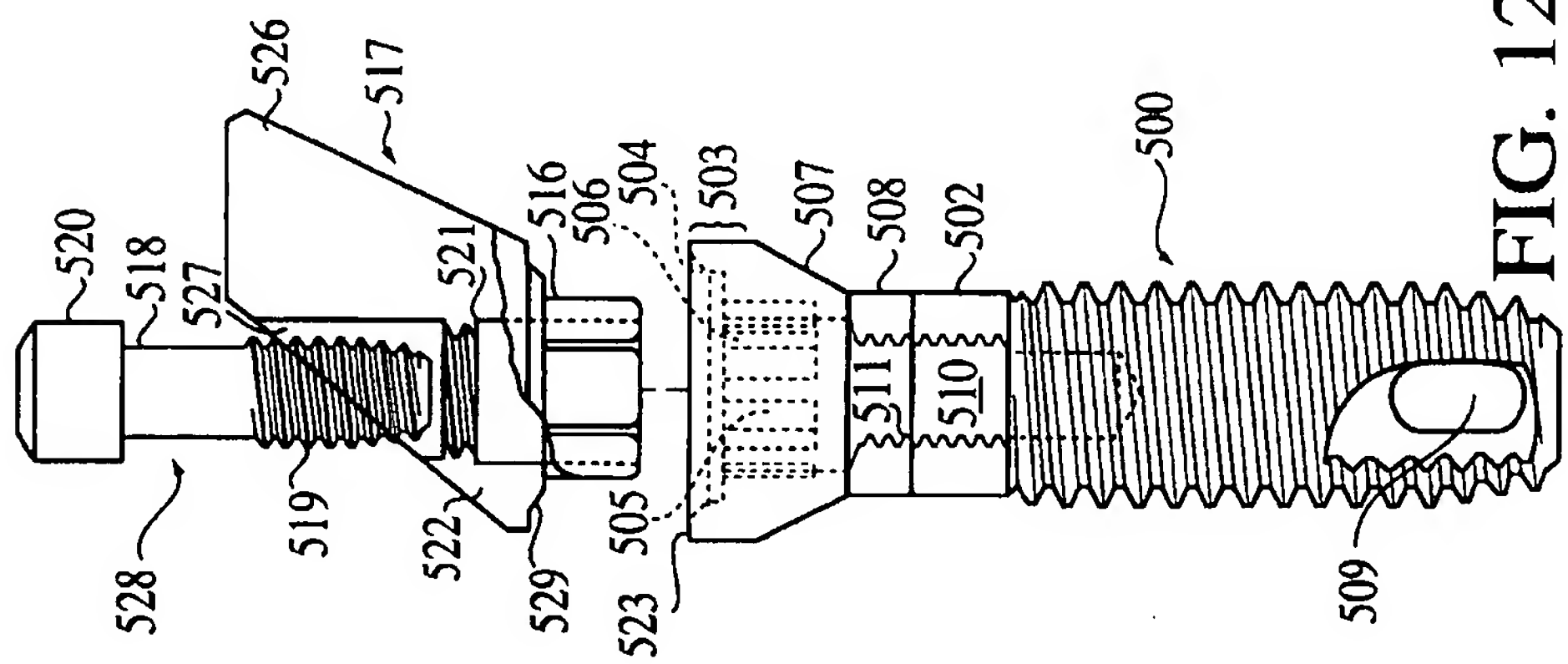
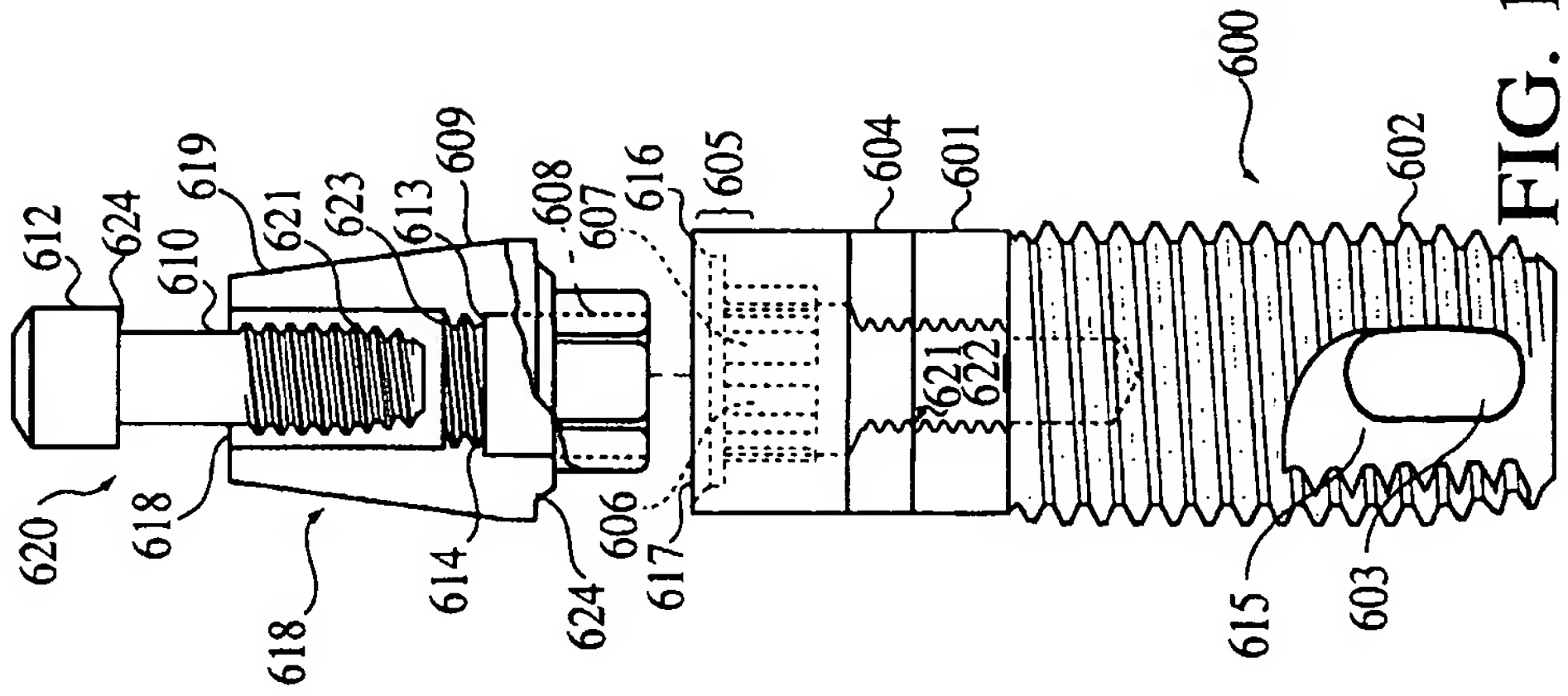


FIG. 7







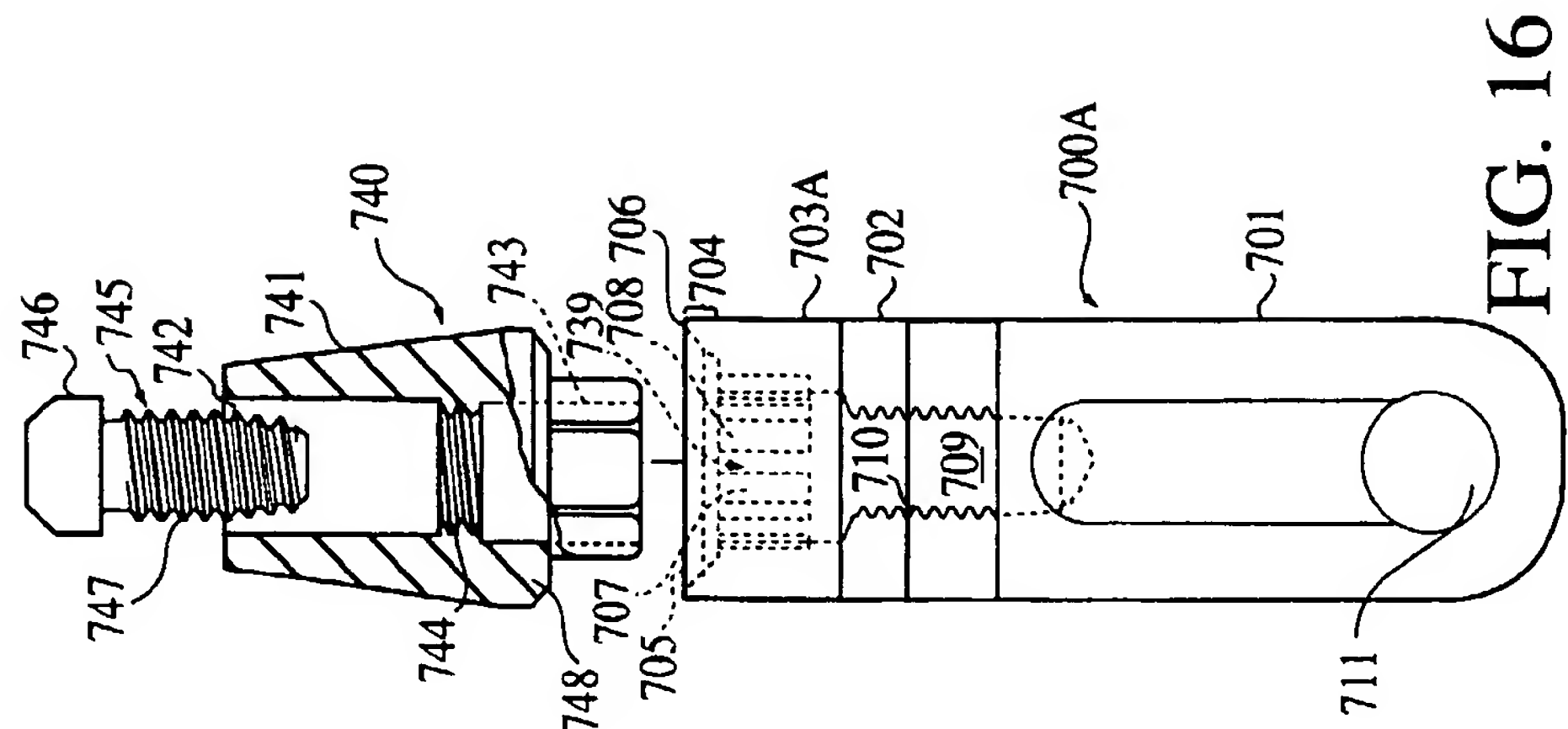


FIG. 14

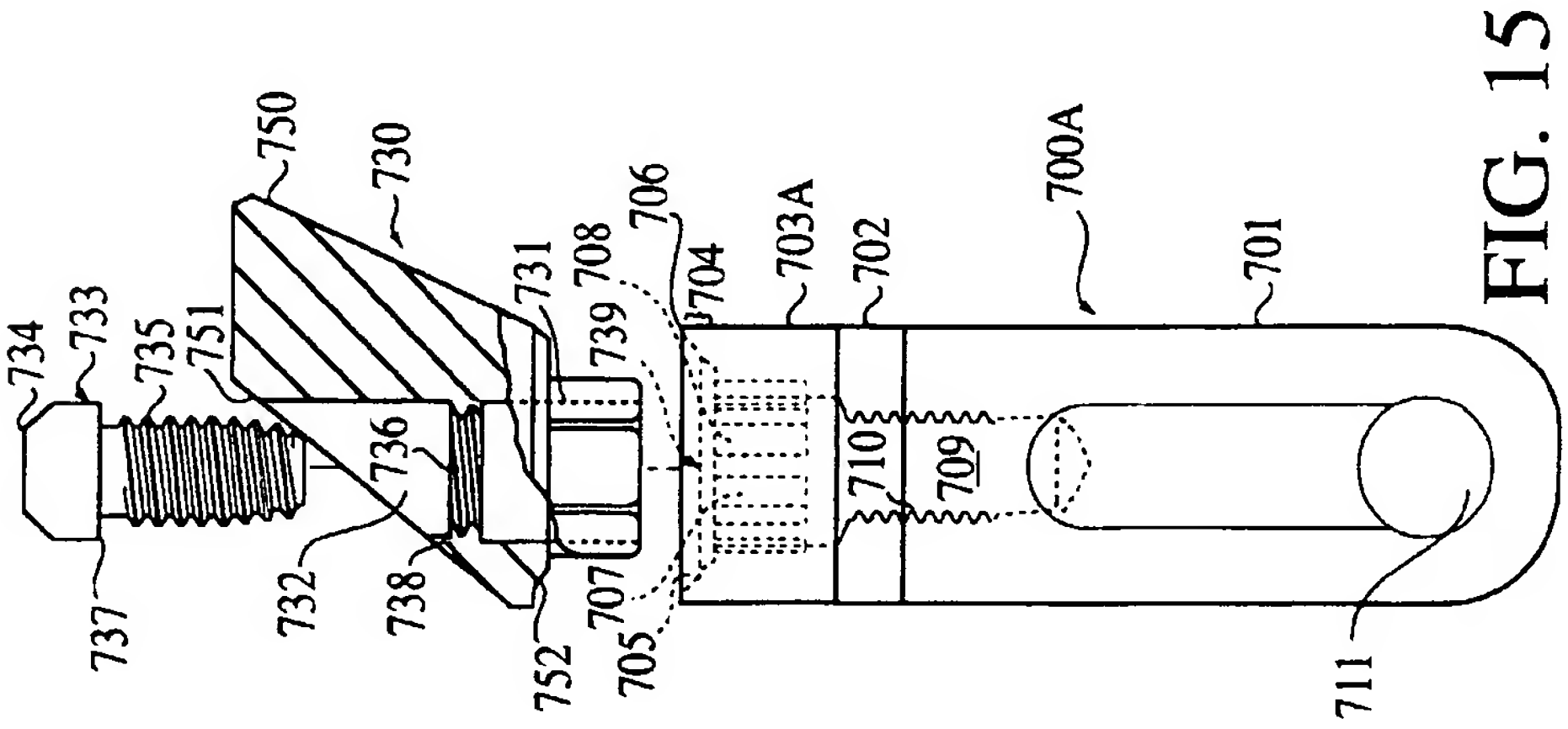


FIG. 15

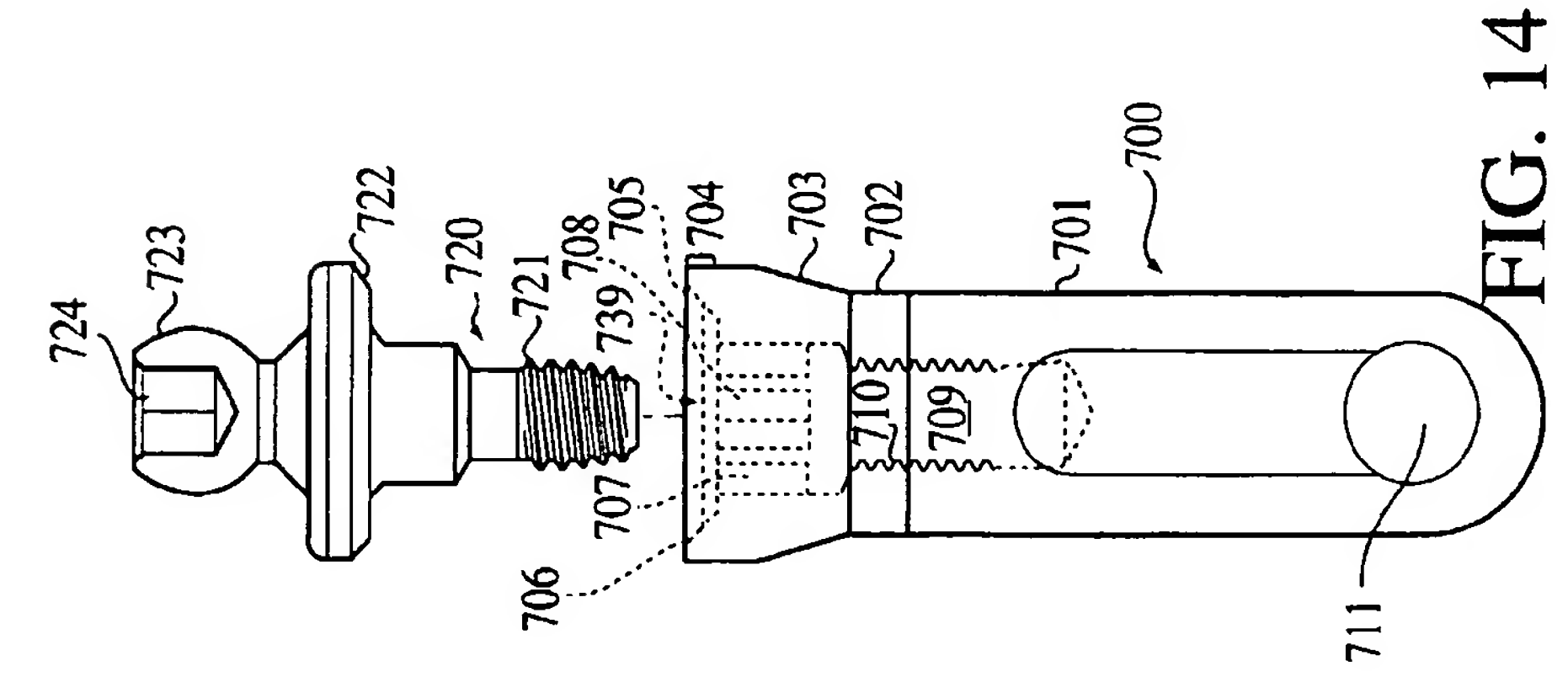


FIG. 16

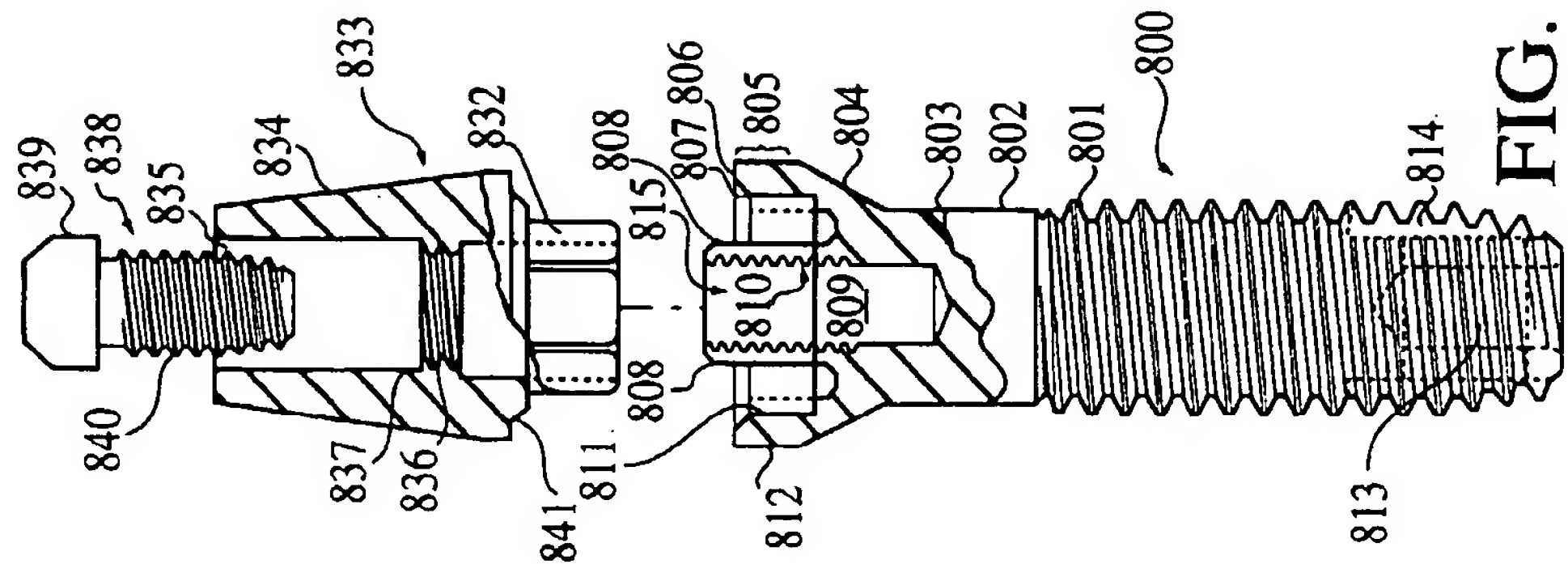


FIG. 19

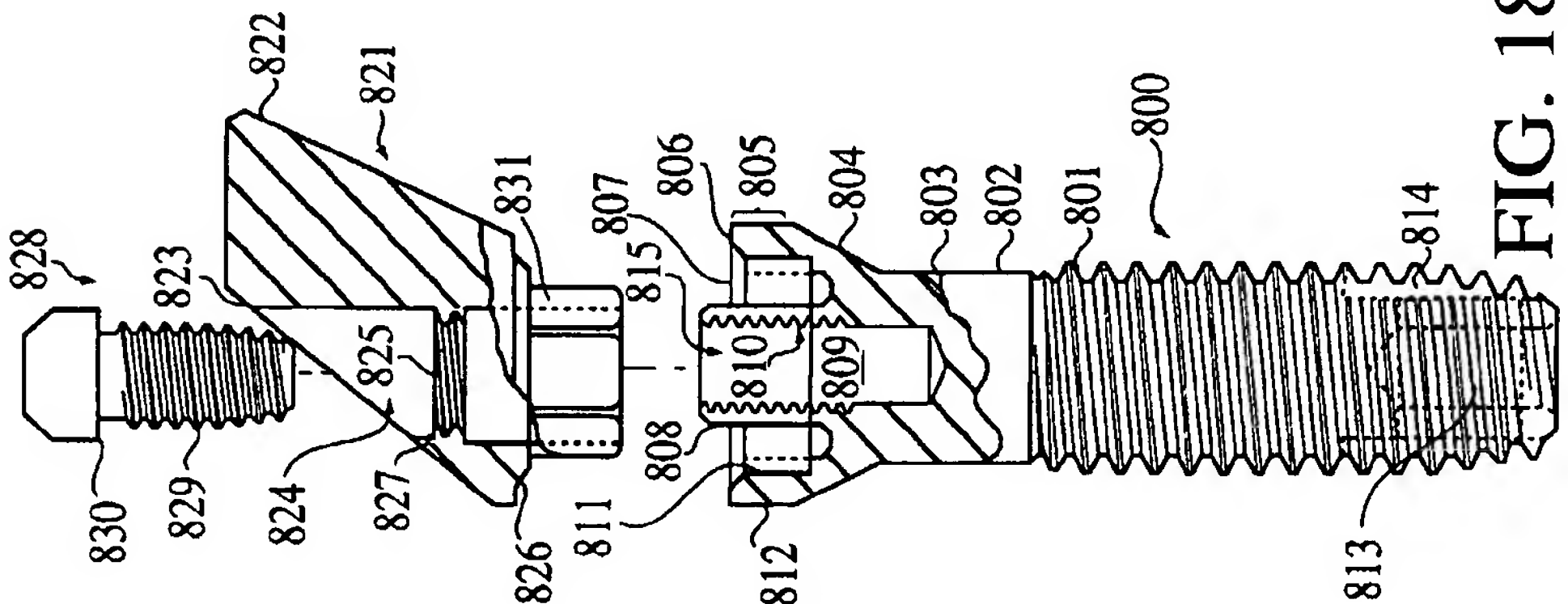


FIG. 18

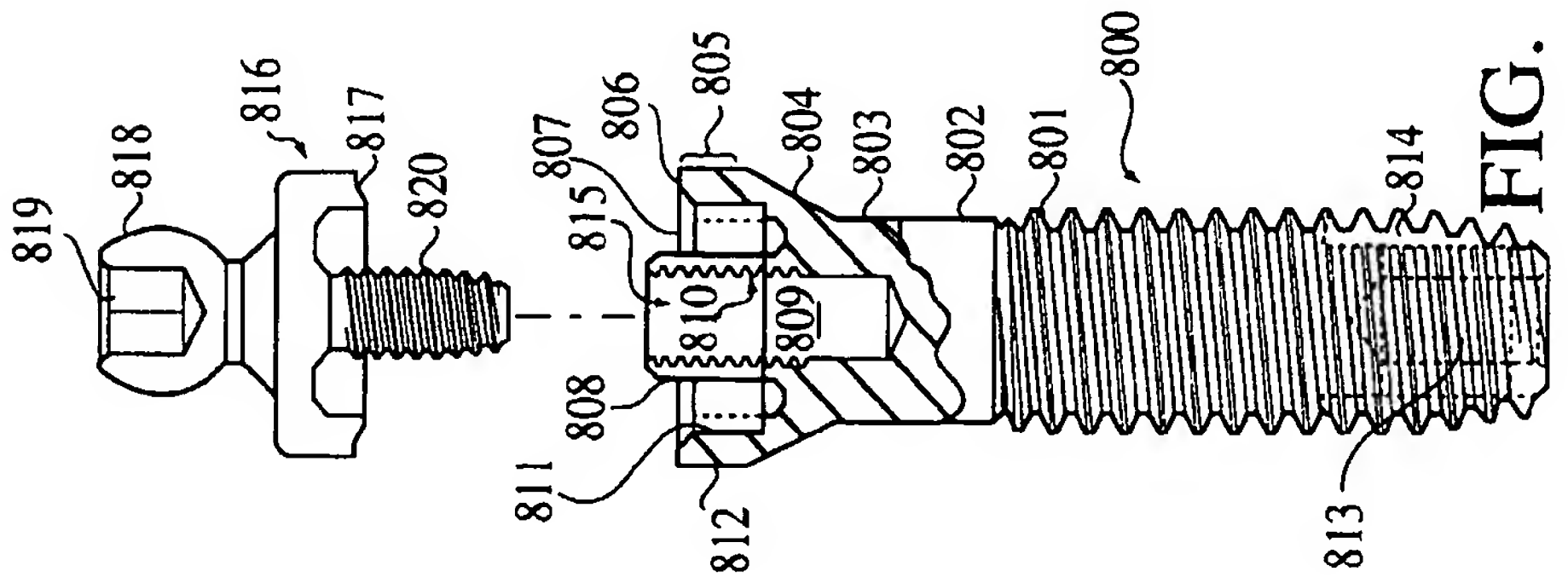


FIG. 17



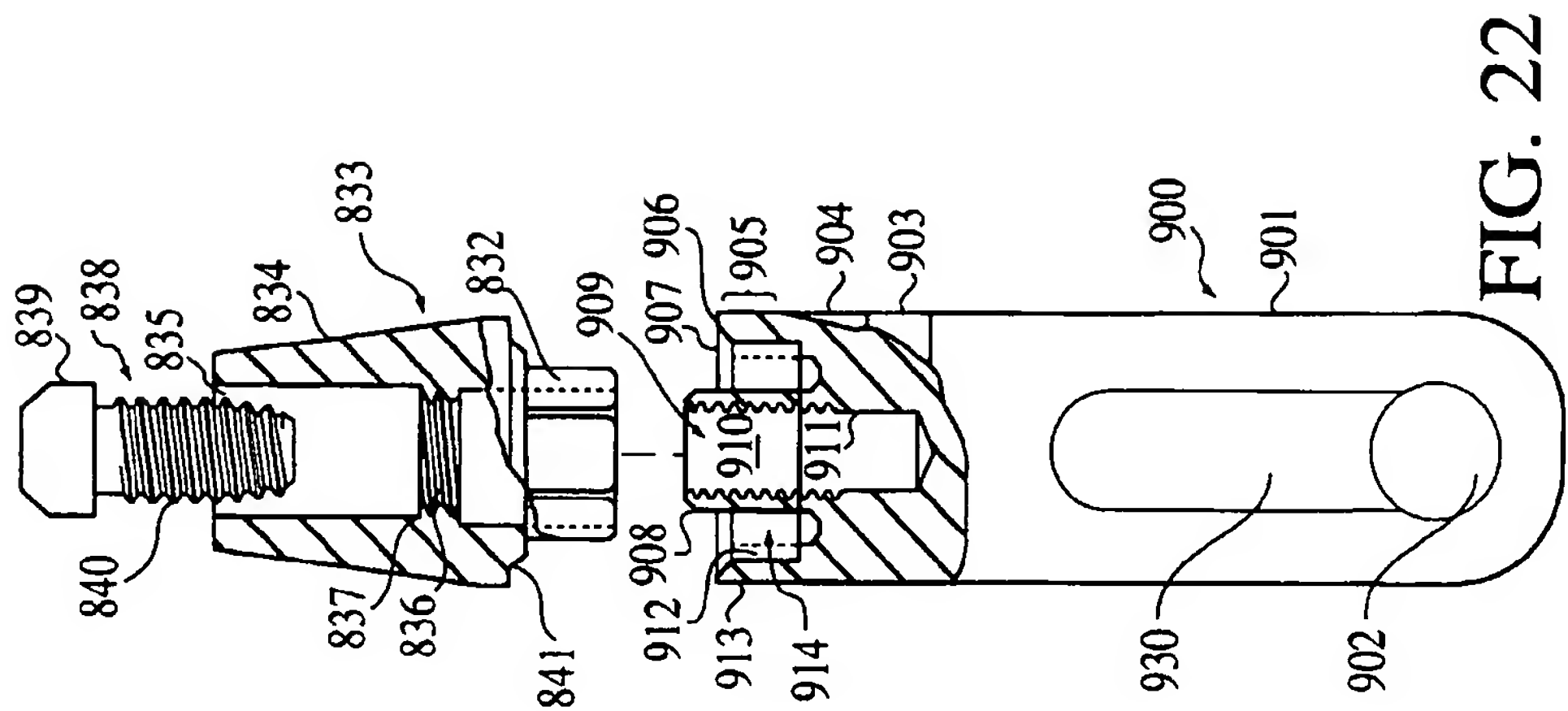


FIG. 20

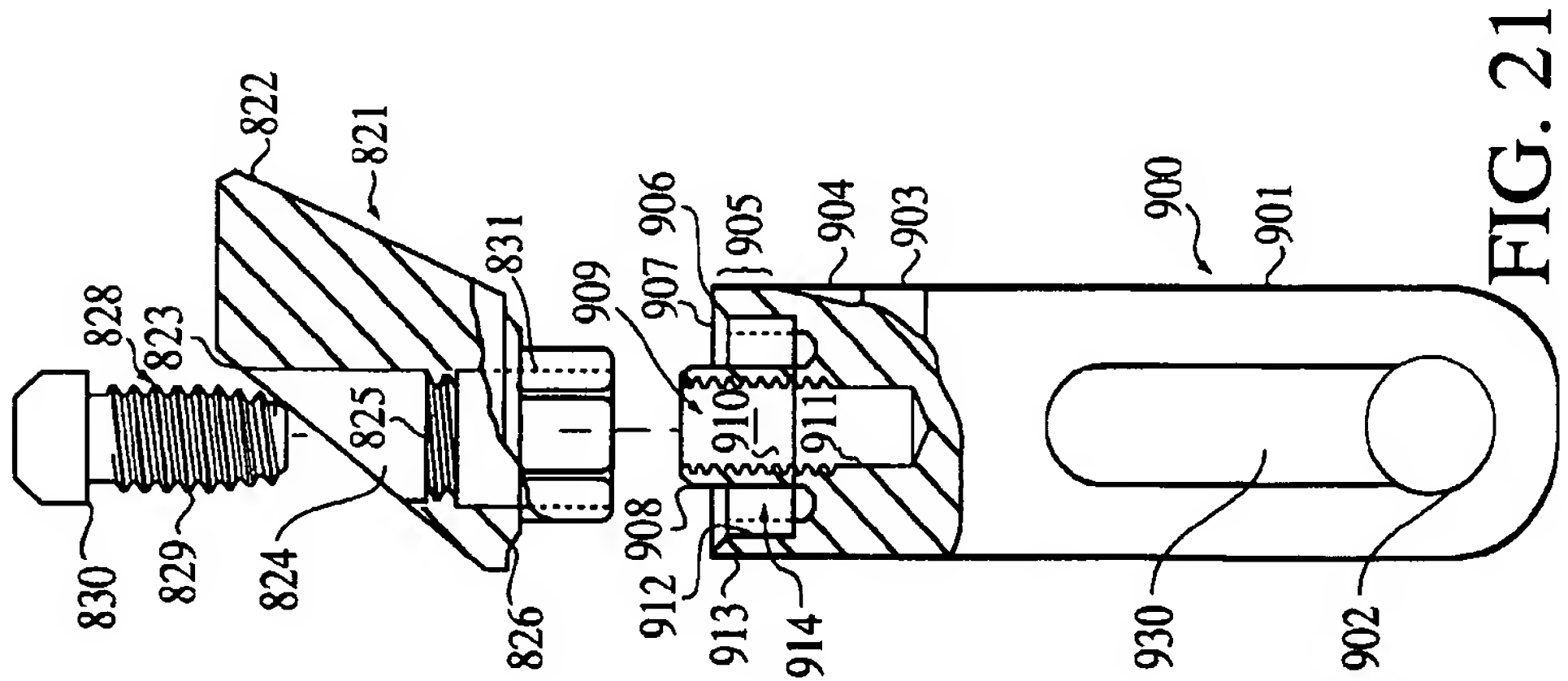


FIG. 21

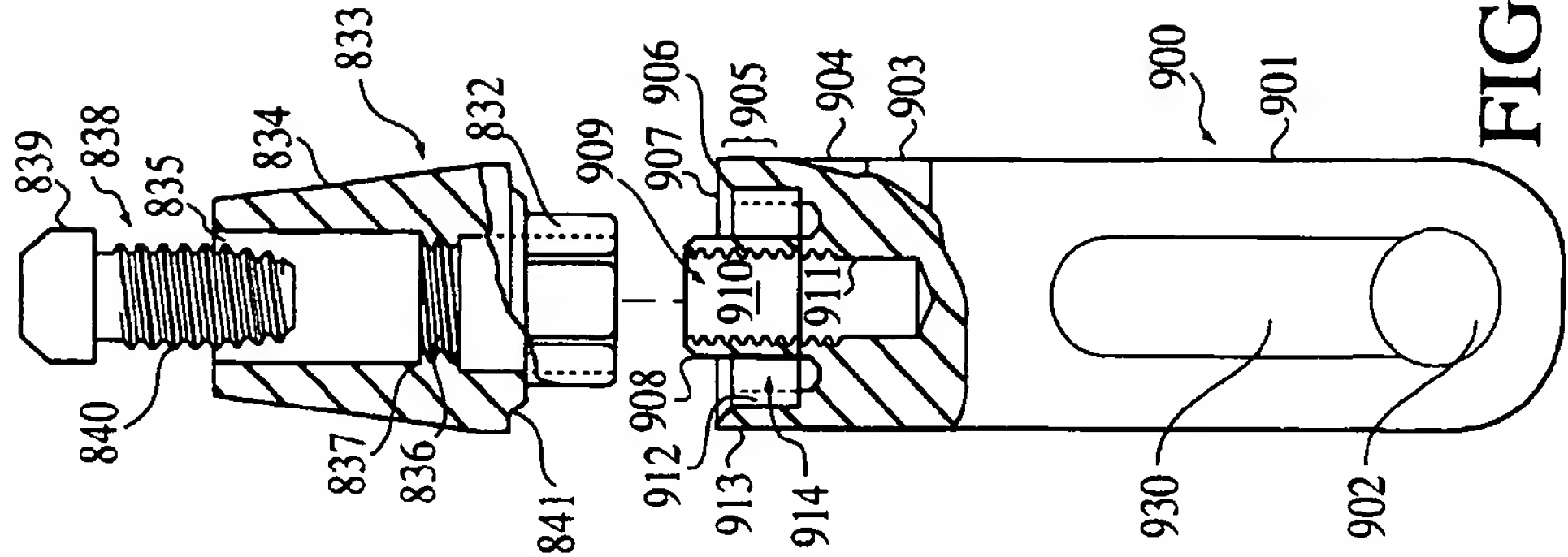


FIG. 22

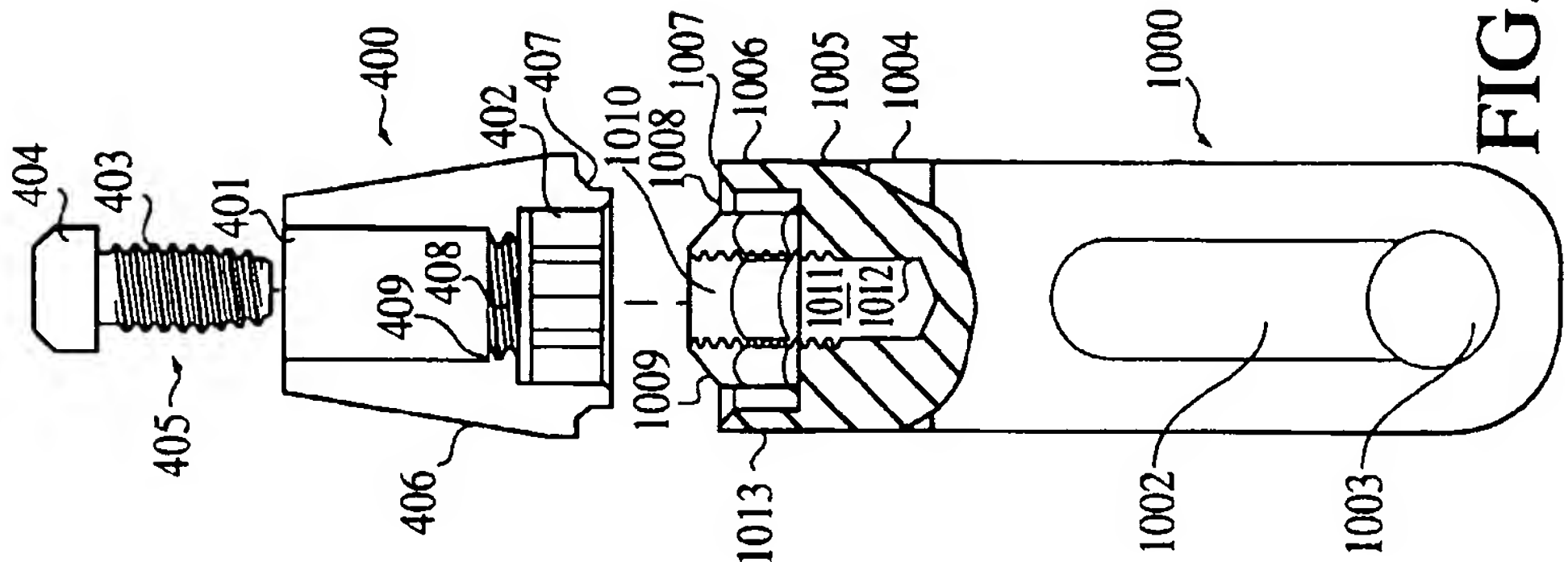


FIG. 25

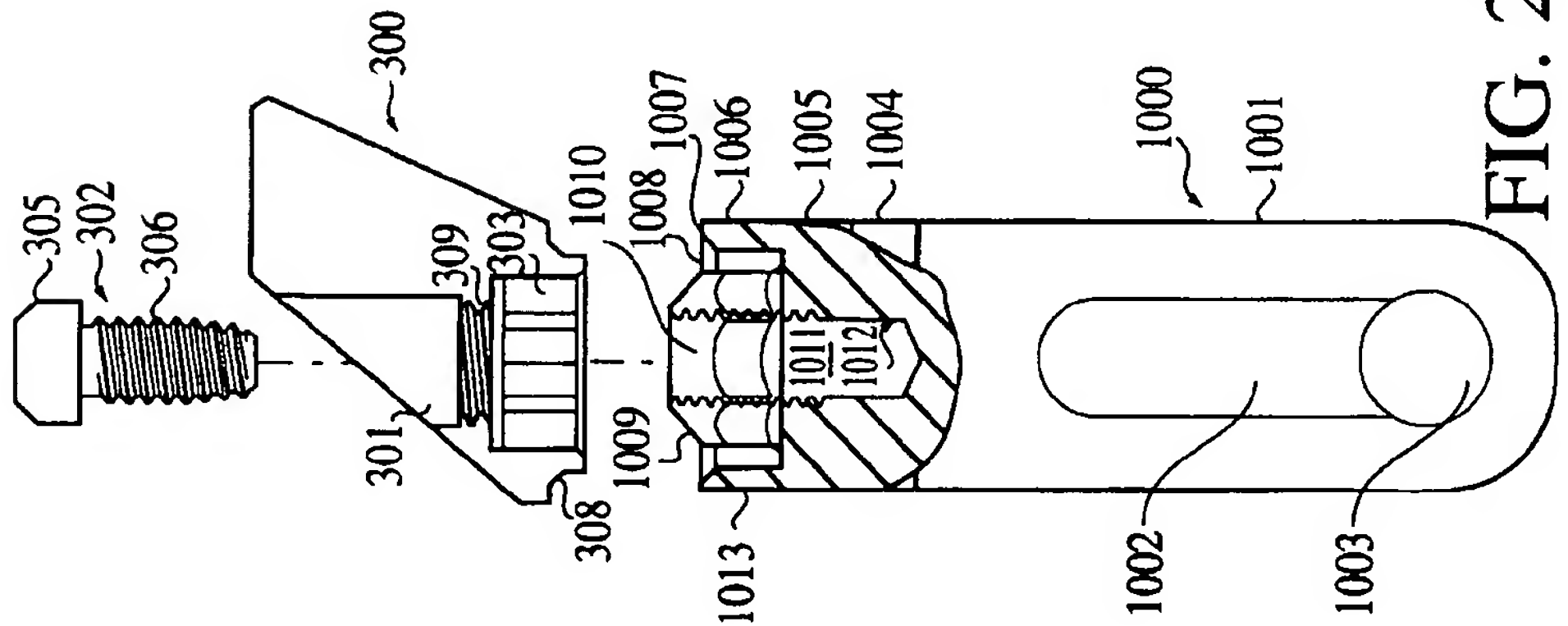


FIG. 24

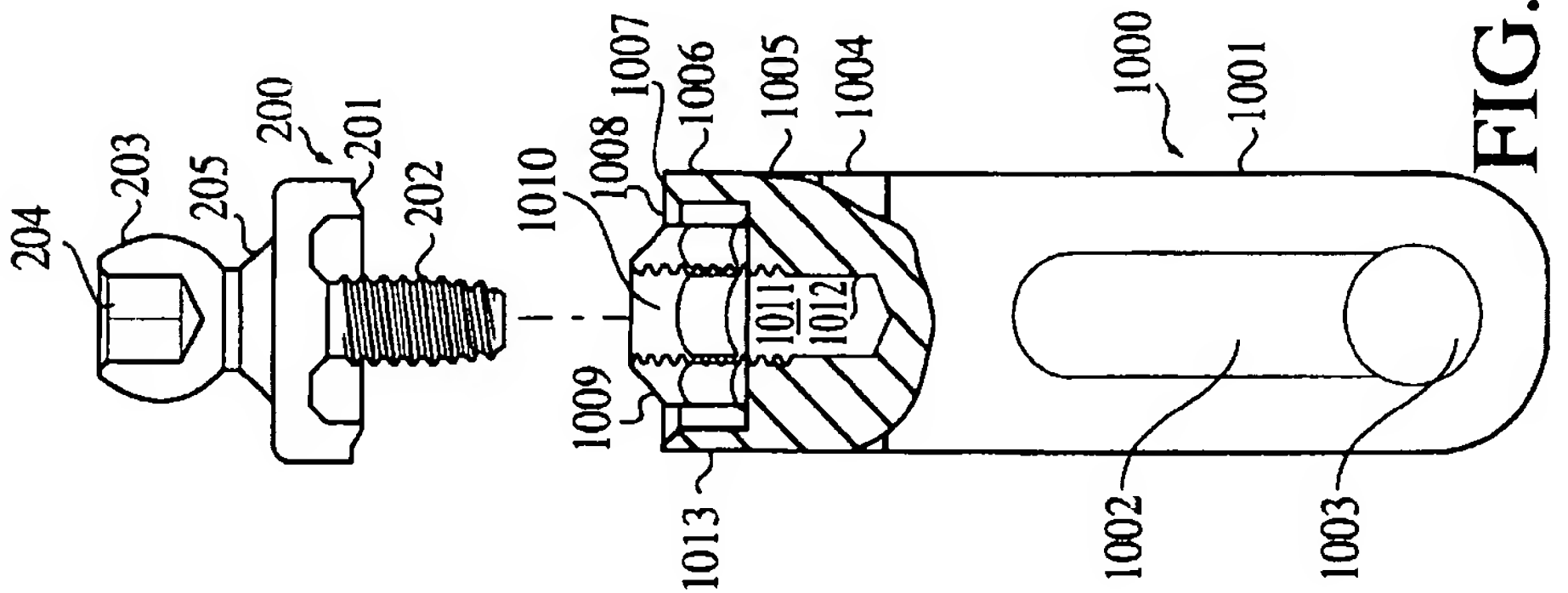
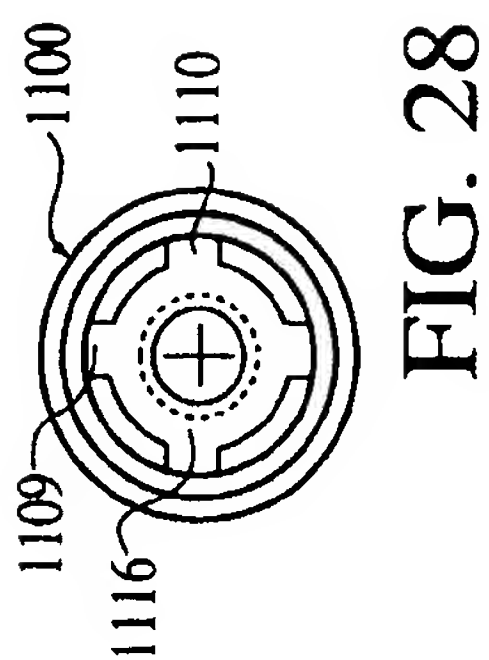
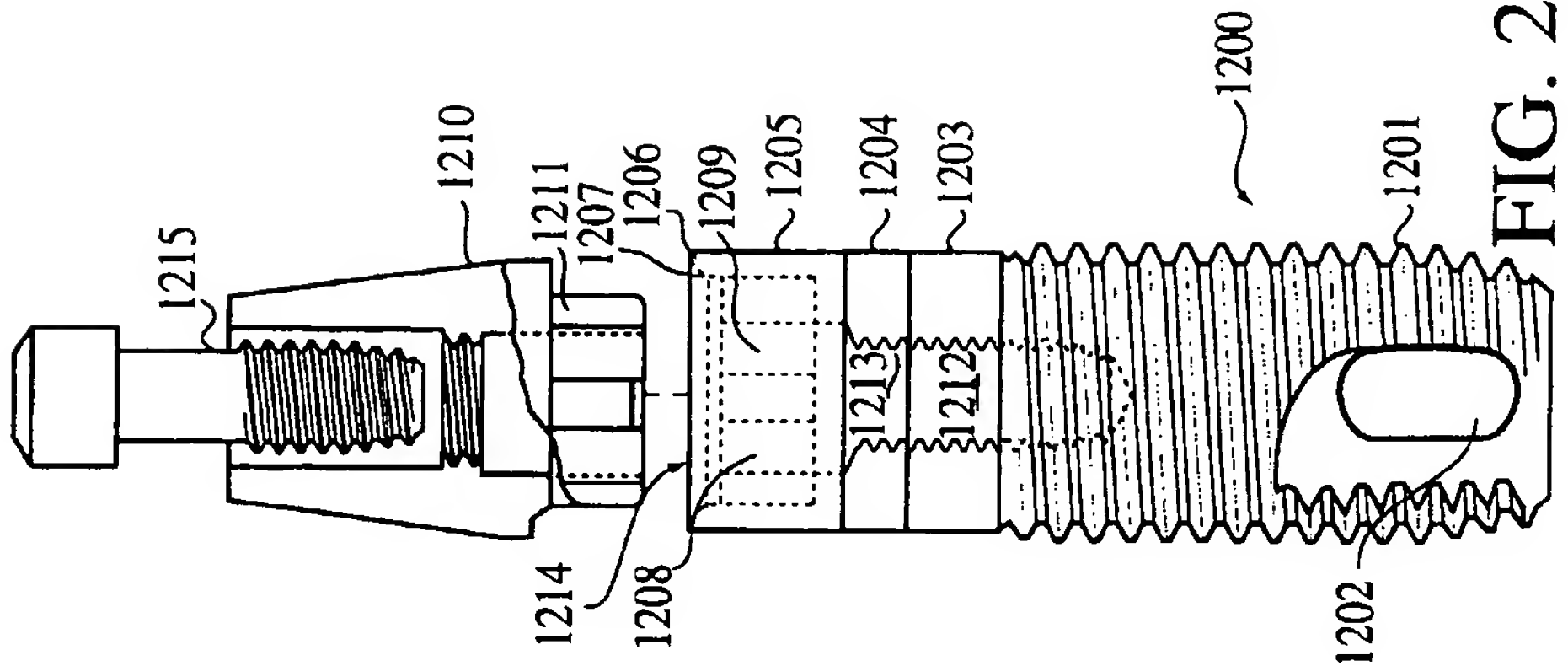
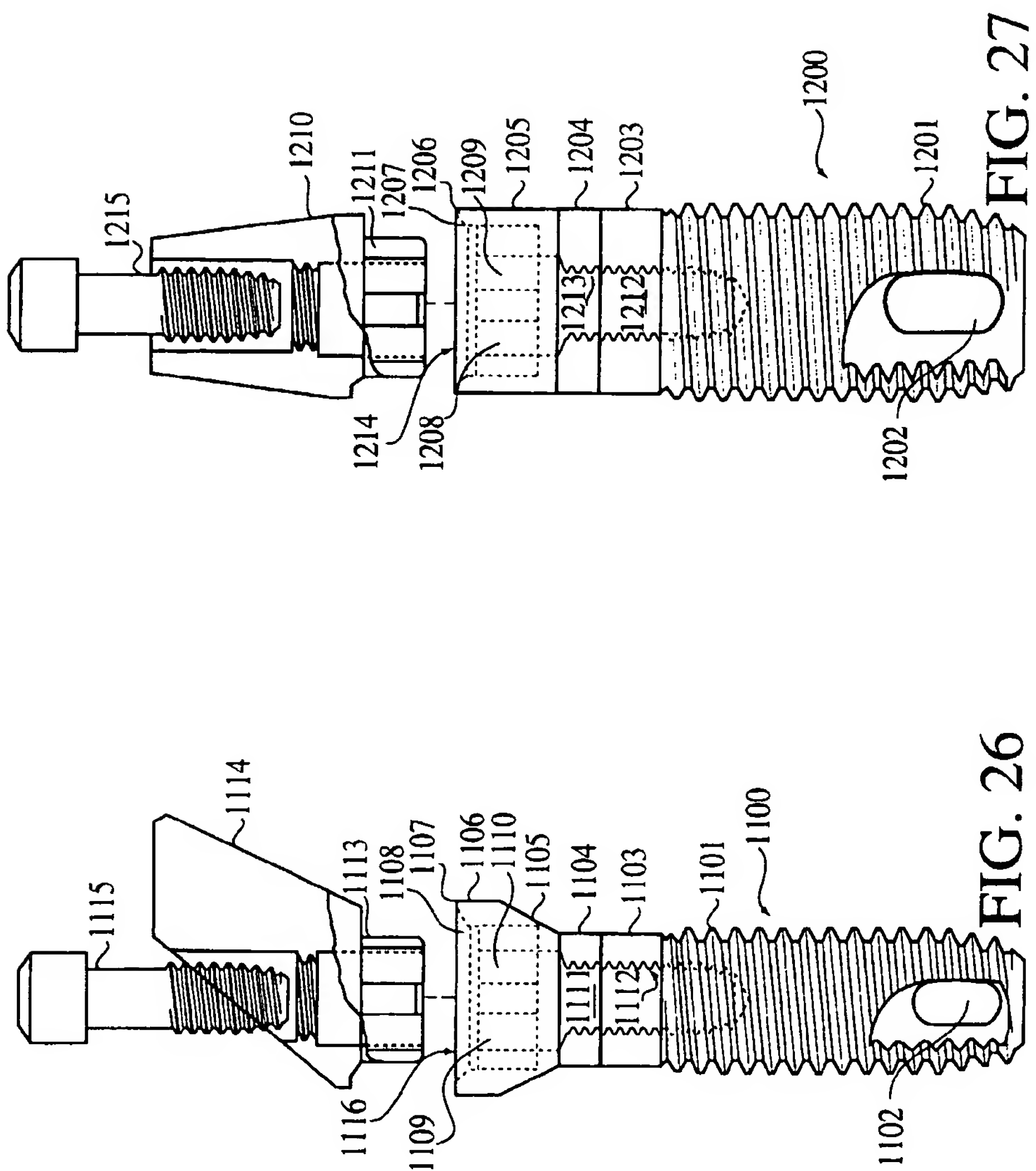


FIG. 23



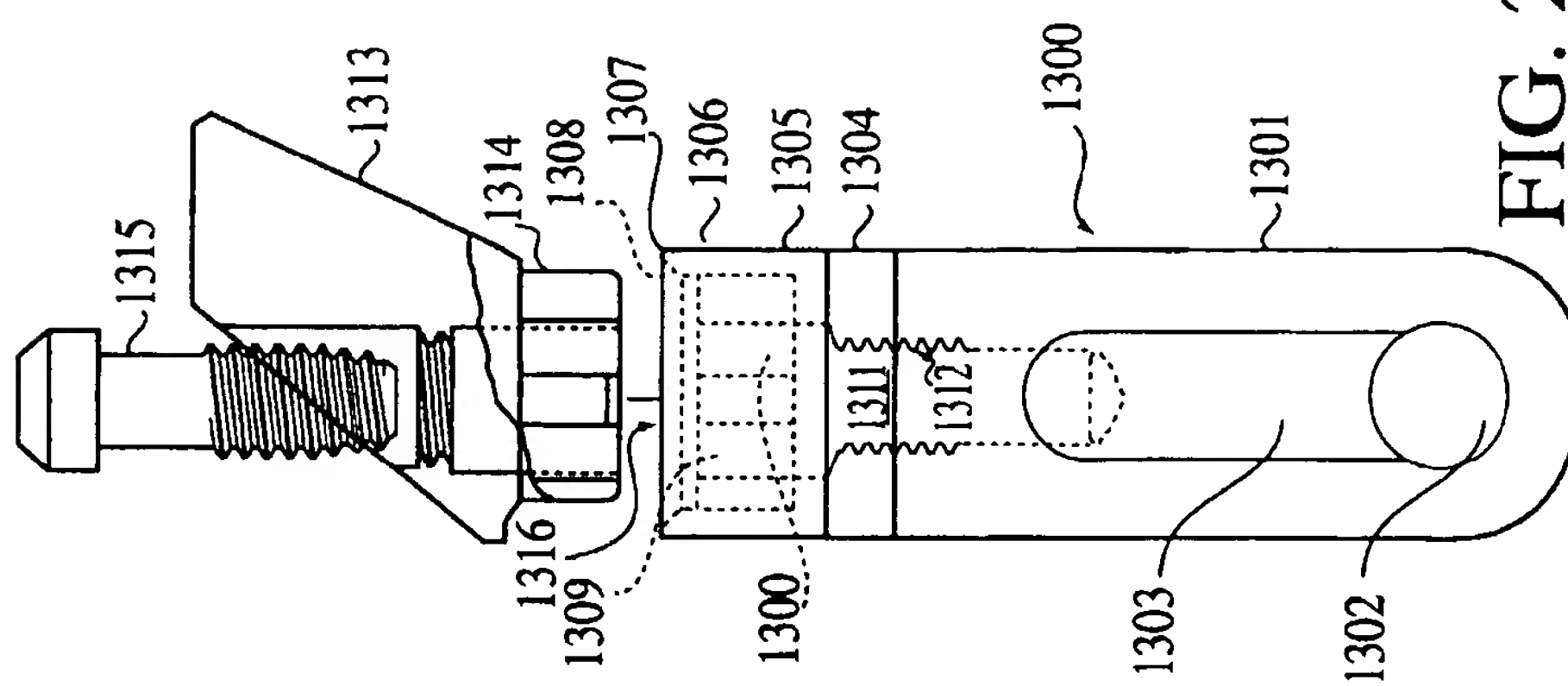


FIG. 29



